Exploring Management Practices of Water Resources and Infrastructure at Local Government Level as a Threat to Water Security in South Africa

Dissertation

Submitted to the Faculty of Military Science, University of Stellenbosch

In compliance with the requirements

for the Degree of Master in Military Science

By

Johannes Hendrikus Botha

Date: December 2020

Supervisor: Prof J.C.R. Liebenberg

DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (except where explicitly stated otherwise), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: December 2020

SUMMARY

Water resources management at local government level were explored as a threat to South Africa's national security. This study made use of a qualitative descriptive approach and an extensive literature review. The background to the current state of water affairs in South Africa and the management of water resources are discussed. The local government was chosen as the unit of analysis, as it serves the people in their communities. A theoretical and conceptual descriptive research approach was used and supported by accessible literature to create a connection between management theory and the current state of water management in South Africa. It is proposed that South Africa should make every effort to identify and address all water-related challenges that may contribute to water insecurity. Public entities are the backbone of the country's water sector, spanning from catchment management agencies to municipal water service providers. They guarantee that there is water in the taps and that wastewater is treated. All businesses and all households use water and dispose of water; therefore water is everyone's business. South Africa's rivers and streams are polluted every day, seemingly without any consequence management.

The evidence shows that there is a loss of strategic direction and a struggle, if not some confusion, at local government level to get the fundamentals right. The basics need to be in place in business so that there is a sound basis from which to build and move forward. The same principle must apply to water management. Under normal circumstances, evidence shows that municipalities are unable to deal with even basic services such as clean water and sanitation, maintenance and repair of existing infrastructure. It is doubtful that local government will be able to deal with these challenges under extraordinary circumstances when extreme events such as droughts and floods take place as a consequence of climate change. Service delivery records indicate that local government is not rendering effective and efficient municipal services to all people. Some municipalities are entirely dysfunctional. In an attempt to identify poor management practices at local government as a threat to water security, it became evident that in cases where municipalities fail to render safe drinking water and dispose of wastewater responsibly, those municipalities are in breach of Section 24 of the Bill of Rights.

Inappropriate and cavalier management practices deny South Africans a prosperous and secure future, as water is the cornerstone to the country's future. Food security and water security are linked, and like a set of dominos that falls due to poor management practices, without water security, national security can come under threat.

Keywords: water security, local government, climate change, management.

OPSOMMING

Die bestuur van waterbronne op plaaslike regeringsvlak is ondersoek om te bepaal of Suid Afrika se stand van nasionale sekerheid bedreig word. Die studie is gebaseer op ’n kwalitatiewe deskriptiewe benadering gepaardgaande met ’n omvattende literatuurstudie. Die agtergrond van wateraangeleenthede asook die bestuur van waterhulpbronne in Suid Afrika word bespreek. Die plaaslike regering is gekies as die eenheid van analise, aangesien dit die entiteit is wat ’n diens lewer aan die mense op voetsoolvlak. ’n Teoretiese asook deskriptiewe benadering is gevolg, gerugsteun deur beskikbare literatuur om die verbintenis te maak tussen die teorie van bestuurspraktyk en wateraangeleenthede. Daar word aanbeveel dat Suid Afrika moet poog om alle bedreigings van waterbronne asook watersekuriteit te hanteer. Burgerlike organisasies vorm die hoeksteen van die watersektor, wat wissel van opvangsbestuuragentskappe tot munisipale waterdiensverskaffers. Alle besighede en alle huishoudings gebruik water en genereer afvalwater. Derhalwe is water almal se verantwoordelikheid. Die land se riviere en strome word besoedel sonder enige klaarblyklike nagevolge.

Daar is bevind dat plaaslike regerings sukkel om die basiese beginsels van bestuur reg toe te pas, asook om strategies rigtinggewend op te tree. Die basiese beginsels behoort gevestig te wees ten einde ’n hegte basis te skep waarop verder gebou kan word. Dieselfde beginsel behoort te geld vir waterbestuur. Plaaslike regerings is onder normale omstandighede nie in staat om basiese dienste soos watervoorsiening, sanitasie of herstel en instandinhouding van bestaande infrastruktuur suksesvol te lewer nie. Dit is dus te betwyfel of hulle onder buitengewone omstandighede, soos wanneer vloede en droogtes weens klimaatsverandering kan plaasvind, in staat sal wees om die uitdagings te hanteer. In breë trekke word uitgewys dat plaaslike regerings toenemend onbekwaam is om effektiewe dienste aan gemeenskappe te lewer. Sommige munisipaliteite het totaal verval in ’n staat van disfunksionaliteit. In ’n poging om swak bestuurspraktyke op plaaslike regeringsvlak te identifiseer, het dit duidelik geblyk dat waar munispaliteite in gebreke bly om skoon drinkwater aan gemeenskappe te lewer, asook om op ’n veilige wyse oor afvalwater te beskik, diesulke munispaliteite Artikel 24 van die Handves van Regte oortree.

Weens onaanvaarbare en onverskillige bestuurspraktyke word Suid Afrikaners die geleentheid misgun om deel te hê aan ’n vooruitstrewende toekoms met water as hoeksteen van ons toekoms. Sonder water is daar geen toekoms nie. Voedselsekerheid en watersekerheid is onafskeidbaar verbind en soos ’n stel domino’s wat val as gevolg van swak bestuurspraktyke, kan onvoldoende watersekerheid nasionale sekerheid in gedrang bring.

Sleutelwoorde: watersekuriteit, plaaslike regering, klimaatsverandering, bestuur

ACKNOWLEDGEMENTS

I would like to express my appreciation to my supervisor, Prof J.C.R. Liebenberg, for his guidance, patience and the support he rendered, even in the early morning hours, to help me express myself on paper. I would like to extend a special word of appreciation to my wife, Bettie, who was a pillar of strength from beginning to end and for countless late-night discussions. Lastly, I would like to thank the South African National Defence College and the University of Stellenbosch, Faculty of Military Science, for the opportunity afforded me to read for this degree.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

4IR	Fourth Industrial Revolution
AG SA	Auditor General of South Africa
CEO	chief executive officer
CMAs	catchment management agencies
CSIR	Council for Scientific and Industrial Research
DA	Department of Agriculture
DEA	Department of Environmental Affairs
DHSW&S	Department of Human Settlements, Water and Sanitation
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EWSETA	Energy and Water Sector Education and Training Authority
FAO	Food and Agriculture Organisation
FY	financial ear
GDP	gross domestic product
HPO	high-performance organisation
IBT	interbasin transfer
IPCC	Intergovernmental Panel on Climate Change
IVRS	Integrated Vaal River System
KZN	KwaZulu-Natal
LHWP	Lesotho Highlands Water Project
MW	megawatts
m^3/a	cubic metres per annum
M&E	Monitoring and Evaluation
NDP	National Development Plan
NEMA	National Environmental Management Act
NPC	National Planning Commission
NRW	non-revenue water
NWRS	National Water Resources Strategy
NW&SMP	National Water and Sanitation Master Plan
PFMA	Public Finance Management Act
RDI	research, development and innovation
SADC	Southern African Development Community
Sahel	North Central Africa South of the Sahara Dessert
SAHRC	South African Human Rights Commission
SALGA	South African Local Government Association
SANDF	South African National Defence Force
Stats SA	Statistics South Africa
SWPN-SA	Strategic Water Partners Network-SA
TCTA	Trans Caledon Tunnel Authority
WSAs	water source areas
WSAU	water service authority
WSIs	water service intermediaries
WSPs	water service providers
WWF-SA	Worldwide Fund for Nature South Africa

LIST OF FIGURES

LIST OF TABLES

OPERATIONAL DEFINITIONS

Ser No	Concepts	Definitions
1	Aquifer	A body of permeable rock that can contain or transmit groundwater
2	COVID-19	A mild to severe respiratory illness that is caused by a coronavirus (*Severe acute respiratory syndrome coronavirus 2* of the genus *Betacoronavirus*), is transmitted chiefly by contact with infectious material (such as respiratory droplets) or with objects or surfaces contaminated by the causative virus. The name designation refers to COVI- for the acronym of coronavirus, D- for the word disease, and 19- for the year of the outbreak. COVID-19 was first identified in Wuhan, China in December 2019. This virus soon became a pandemic and killed thousands of people across the world.
3	Desertification	The process by which fertile land becomes desert
4	Disaster	A disaster is characterised as a progressive or unexpected, widespread or localised, natural or human-made occurrence that seriously interferes with the functioning of a community, causing human, material, economic and environmental loss that surpasses a society's capacity to use its own resources to the degree that assistance from outside parties is required.
5	Ecological reserve	Water systems that have enough water to sustain the living resources on which human beings depend
6	Eutrophication	Process related to excessive nutrient enrichment due to river phosphates that cause exponential growth of algae and other aquatic plants. This eliminates many organisms, which may cause fish to starve, as the algal bloom decomposes when the available oxygen is exhausted.
7	Famine	Extreme scarcity of food, lack of food or undersupply/unavailability of food.
8	Groundwater	Groundwater comprises all underground or subsurface water contained in rocks, rock cracks, crevices and aquifers. It emerges as springs and is abstracted from boreholes or wells.
9	Hydraulic fracturing	Also known as fracking. It is the process of injecting pressurised fluids into various rock layers in order to create cracks to allow natural gas to move freely.
10	Local government	Local sphere of government that must ensure that functional strategies, policies, programmes and projects find embodiment at community level. Local government can imply the local municipality, district municipality or metropolitan municipality. When referring to local government, it can imply each entity individually, depending on the context, or collectively when referring to local government in a broad context.

Ser No	Concepts	Definitions
11	Salination	Salination is induced by intrusion of seawater or intense farming activities such as the production of citrus fruits and grapes utilising widespread fertilisation.
12	Semi-arid	A semi-arid area or climate receives little rain but is not completely dry.
13	Surface water	Surface water comprises rivers and lakes and is mostly used for the supply of large urban resources. Rivers, wetlands, estuaries, springs and aquifers are all natural water supplies, replenished by precipitation (WWF-SA, 2016: 8).
14	Transboundary flow	Water flowing across borders or between countries, i.e. shared between neighbours. Water sharing or transboundary flow accounts for 60% of available water resources.
15	Water footprint	The volume of water required for producing a product or service, including soil water (known as brown water), river and aquifer water (blue water), and water affected by waste materials (grey water). Often recognised as virtual water or embedded water (WWF-SA, 2016: 86)

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

The management of water resources at local government level were explored as a threat to water security in South Africa. The topic was explored by using a qualitative descriptive approach and an extensive literature review. In the course of extensive reading, categories and sub-themes were identified and supported by relevant data. In conclusion, on the basis of the findings the researcher has attempted to make recommendations to overcome identified threats. In this chapter, the background of the current state of water affairs in South Africa as well as the management of water resources is discussed. The problem statement that expands on the need for this study follows. Local government was chosen as the unit of analysis for the study. This level of government is responsible for service delivery closest to the people, and management on this level has a direct influence on the quality of life of the communities involved.

1.2 RATIONALE

The following statement, taken from the National Water and Sanitation Master Plan (2018b), lies at the heart of the present problem in South Africa:

> South Africa is facing a water crisis caused by insufficient water infrastructure maintenance and investment, recurrent droughts driven by climatic variation, inequities in access to water and sanitation, deteriorating water quality, and a lack of skilled water engineers. This crisis is already having a significant impact on economic growth and on the well-being of everyone in South Africa (NW&SMP, 2018b: 1).

Climate change as an environmental factor plays a role and is a global phenomenon. Water has always been and remains a scarce resource in South Africa (Turton, 2008: 2; Department of Science and Technology, 2010: 22). Global warming is occurring and is a contributing factor to climate change (Hart-Davis, 2009: 279, 414, 415, 418, 419). Because of earth warming, projections of changes to rainfall become less reliable, and as a result, the impact on the water cycle is not as fully understood as previously. Water managers find it increasingly difficult to predict changes in the water cycle, which in turn creates uncertainty when attempting to integrate the impact of climate change in planning processes. The agricultural sector, which annually uses 62% of the total water resource (Department of

Science and Technology, 2010: 28) in South Africa, is vulnerable to climate change. If it does not rain, agriculture ceases to exist, posing a challenge to water and food security. Ecosystems will inevitably come under stress in situations where communities experience problems with water scarcity (Department of Science and Technology, 2010: 28).

The Department of Science and Technology (2010: 29) projects that South Africa can expect an increase in extreme environmental events. Such adverse events may harm the quality and quantity of available groundwater reserves and surface water at the country's disposal at any given time. Droughts and floods are being categorised by the Department of Science and Technology (2010: 29) as extreme events and can be categorised as follows:

- **"**A decrease in water quality can be anticipated owing to saltwater intrusion.
- An increase in the occurrence of international water conflicts may develop.
- A decrease in water quality due to run-off and erosion will take place.
- A decrease in agricultural development and profits due to droughts can also be expected".

Water and water management are factors in security and conflict, going back to ancient times. Water is central to the life of the planet, affecting fauna and flora, agriculture and the lifespan of humans and non-human animals alike (Hart-Davis, 2009: 279, 334ff, 362-363). Lack of water is likely to lead to food insecurity, loss of quality of life and in turn, tension and conflict. It is well documented that civilisations have collapsed over the ages because of insufficient access to water resources (Iceland, 2017, as cited in Gleick & Iceland, 2018: 3). South Africa shares a water security challenge with many other countries and communities on the globe. "Water scarcity and impurity - and the conflict that it can cause - is a daunting threat to the world's more than seven billion people" (Blanton & Kegley, 2017: 473) and has the potential to become an even bigger threat to security as the world population is on the rise.

Access to water has already caused much conflict and unrest in South Africa. Rapid population growth, environmental degradation and increased water consumption are all contributing factors that place access to water under strain. These pressures combined make it vital that solutions to water challenges be found and implemented (Gleick & Iceland, 2018: 3). Given the current situation in South Africa and keeping in mind the droughts that certain regions in South Africa experienced over the years and more acutely during recent times, the warning of Jean Chrétien is highly relevant: "The future political impact of water scarcity may be devastating […] using water the way we used it in the past, will certainly not sustain humanity in the future" (Blanton & Kegley, 2017: 473). This holds true for South Africans as well.

Water insecurity has rarely on its own caused political instability and conflicts in a region. Instead, water insecurity should be seen as a contributing factor to instability (Gleick & Iceland, 2018: 1). A contributing factor, but not the causal factor to instability, may be limited or restricted access to water. Water-related security events begin as localised crises and then have further consequences. A local water crisis may have spill-over effects that may threaten national, regional, and global stability. Water problems do not necessarily lead to conflict, migration, or acute food insecurity. It seems that in such instances, negotiation, communication and cooperation become crucial in dealing with the water challenges (Gleick & Iceland, 2018: 5). The need to deal with water challenges led to water management being addressed in this study. Countries such as South Africa should make every effort to identify water-related challenges that can contribute to security threats by developing and implementing strategies to address those threats effectively and efficiently (Gleick & Iceland, 2018: 5). This study explored this issue in more detail.

Research may start from a hunch. In this case, the hunch demands some deliberation. As a baseline and interpreted in conjunction with the goals for economic development as set out in the National Development Plan 2030 (NDP), formulated by the National Planning Commission (NPC) (2012: 205), this was explored further. The chosen frame of reference was to aim at determining the root causes of these issues and whether they can be traced back to pure lack of political will to engage in the water debate or to other reasons. Another relevant question is, “Are there other underlying factors that need to be explored to determine where South Africa finds itself now with regard to water management?” The Vaal River crisis, for example, can be traced back to 2008 (Phakgadi, 2018: 2). It is uncertain why this crisis was left unchecked until 2018, when the Human Rights Commission was tasked to investigate it (Phakgadi, 2018: 2). When studying the literature, the same pattern seems to emerge repeatedly.

In *Engineering News* dated 20 November 2015, Mavuso reported that a well-known researcher in the field, Dr Anthony Turton, was on record as stating that South Africa was on the verge of a human health crisis of unprecedented proportions because the country managed water infrastructure poorly. The worst systemic failure the drought would reveal was the near-total collapse of effluent management and processing systems countrywide (Turton & Henwood, 2002: 195; Mavuso, 2015: 3). Note the importance that Turton attached to the term “management of water” (Mavuso, 2015: 3).

The Department of Science and Technology (2010: 28) has stated that the challenge facing a water-scarce country like South Africa is the inadequate and limited supply of water resources available to meet all growing requirements for humans and the economy. It is a fact

that especially in rural areas, groundwater is the primary resource for domestic use, whereas it supplies a small proportion of the total resources on a national scale (Department of Science and Technology, 2010: 28). The same applies to less water-rich local government areas. Climate change, increased competition for water between the various water use sectors and frequent and prolonged droughts are aggravating factors contributing to water scarcity. It is further reported that this challenge is deepened by the geographic misalignment of the water resources and requirements in South Africa. Water shortages do not target a single target group or industry in the country, but may have a negative impact on the health sector, food security, economic development and job creation in a region (NW&SMP, 2018a: 3-26). Again, the above-mentioned issues are relevant for local government and the communities under the jurisdiction of a three-tier government.

The National Water and Sanitation Master Plan (NW&SMP, 2018a: 3-27) has reported that apart from some large surface water schemes, such as the Lesotho Highlands Water Project (LHWP) Phase 2, that are currently being planned and developed, South Africa is approaching a point where it will be in a compromised position. Very little manoeuvring space will be available, as it will soon reach a stage where all available surface water yields are fully committed and the country will be running out of suitable sites for developing large dams. For this reason, other options, including groundwater, re-use and desalination, are being considered.

South Africa's water sector faces significant challenges. Old infrastructure is either not maintained or has reached the point where it can no longer be repaired and new infrastructure is not being developed and maintained. It is also widely reported that drinking water is not clean, and effluent is not treated. Kings (2018b) reported that billions of rands are mentioned when talking about the cost of solving this crisis. The money that is spent on infrastructure maintenance and development seems to have little or no effect on the overall problem. Another solution is needed (Kings, 2018b).

According to the NW&SMP (2018b: 1), the following (as directly quoted from the literature) can be listed as indicators of the problem areas to which attention should be directed with regard to water management in South Africa:

- "14.1 million people do not have access to safe sanitation;
- Only 64% of households have access to a reliable water supply service;
- 56% of wastewater treatment plants do not properly work, and 44% of the 962 water treatment plants are in a weak or critical condition and need urgent rehabilitation and skilled operators. Some 11% of treatment plants are totally dysfunctional;

- It is estimated that 41% of municipal water does not generate revenue. 35% is lost through leakage;
- Municipalities are losing about 1660 million cubic metres (m^3) per year through non-revenue water. At a unit cost of R6/m^3, this amounts to R9.9 billion each year;
- In April 2017 14.1 million people still used sanitation facilities below the Reconstruction and Development Programme (RDP) standard. Only 10,3 million households (64%) have access to reliable water supply;
- Between 1999 and 2011 the extent of main rivers in South Africa classified as having a poor ecological condition increased by 500%, with some rivers pushed beyond the point of recovery;
- South Africa has lost over 50% of its wetlands, and of the remaining 3.2 million hectares (ha), that is, one third are already in poor condition;
- Water is severely under-priced, and cost recovery is not being achieved. To achieve water security for South Africa, an estimated capital funding gap of around R33 billion per annum for the next ten years must be closed through a combination of improved revenue generation and a significant reduction of costs ;
- South Africa has four internationally shared river basins that contribute 45% of the country's total river flow. These resources must be shared equitably with neighbouring states who also have increased water needs due to growing populations and economies;
- Municipal water reticulation infrastructure includes more than 290 000 km of pipelines, an estimated 7,7 million house connections, over 5 million yard taps and more than 2,1 million street taps" (NW&SMP, 2018b: 15).

Municipalities (local government structures) figure prominently in the management of water and water infrastructure. South Africa is one of the 40 driest countries in the world, with an annual average rainfall of less than 500 mm (Meissner, Steyna, Moyoa, Shadunga, Masanganea, Nohayia & Jacobs-Mata, 2018: 1). In addition, South Africa's rate of economic development is intricately linked to and therefore limited to its level of water security. Rising water consumption, shifting rain patterns, flooding, inadequate access to safe drinking water and sanitation all contribute to restrictions on economic development on all levels of government. The situation is exacerbated by higher levels of water pollution, which in turn can hinder South Africa's much needed economic growth, according to Meissner et al. (2018: 1).

Considering the findings in the International Bank for Reconstruction and Development Report (2018: 6), it is evident that poverty and foreseeable population growth will place additional strain on the availability of already scarce resources. These factors can be seen as ingredients in the proverbial pressure cooker, causing a perfect storm in the making as more

strain is placed on the environment. This must be read in conjunction with the impact of climate change on agriculture. It was reported that if El Niño reached full strength in 2019, South Africa would be facing severe challenges (Kings, 2018a). It is envisaged that the lack of water can trigger a humanitarian crisis in the region, spilling over into neighbouring countries and thus having an adverse impact on the geopolitical stability of the continent.

To understand the inadequate management practices of water resources as a threat to water security, the connection has to be made between water security, food security, human security and national security, which all interlink as part of a bigger system. What happens in one sector will have a knock-on effect in the next sector. One cannot address water security without addressing the other sectors. The overarching element is the economy, which is the driving force, the engine room of South Africa, with the challenges it poses to address poverty, unemployment, human settlement, economic growth, health care for all, infrastructure development and schooling (Mulaudzi & Liebenberg, 2017: 47). All these challenges must be addressed within the constraints of the fiscus, whether on national, provincial or local levels.

Managing the challenges associated with poverty, inequality and unemployment will require a capable state, the key determinant of a developmental state. A developmental state should have the ability to guide, monitor, and intervene in policymaking, execution, and the re-designing of policies that prove counterproductive. This includes the need for a sustainable supply of clean and potable water to communities, whether urban, peri-urban, or rural. In essence, in this envisaged developmental state, the role of the state would be to serve as an enabler to ensure that essential services are provided to communities (Mulaudzi & Liebenberg, 2017: 41).

1.3 THE RESEARCH PATH

The NW&SMP (2018b: 1) identified several factors that are relevant to the research problem under investigation. An extensive literature study, as data collection method and research process, was undertaken to determine the nature and impact of threats to water security at local government level and to make recommendations on overcoming the threats. The research problem as focal point formulated in question format is: "**Are the management practices of water resources and infrastructure at local government level a threat to water security in South Africa?"**

Aim: The aim of this study was to identify, explore and describe how the management practices of water resources at local government level can be a threat to water security in South Africa. Recommendations on overcoming the threats to water security are proposed to ensure national security in South Africa.

Objectives:

Objective 1: To identify and explore management factors at local government level that may have an adverse effect on water security.

Objective 2: To identify and explore environmental factors that may have an adverse effect on water security if not planned for at local government level.

Objective 3: To identify and explore possible steps to improve the current situation to ensure water security at local government level, through a literature review and analyses.

Based on the research problem, the objectives and aim, the following research questions, which are closely related to the aim and objectives of this study, are stated as follows:

1 What are the human factors at local government level that can have an adverse effect on water security and should be managed through continued intervention?

2 Which environmental factors may have an impact on water insecurity if left unchecked and should be planned for at local government level?

3 What are the proposed recommendations to prevent water insecurity at local government level?

1.4 THEORETICAL AND CONCEPTUAL FRAMEWORKS

A theoretical framework was developed by using Fayol's management theory as a basis. Through the years, management theories have evolved and become more multi-faceted. The emphasis shifted from behavioural science to the organisational framework and quality assurance (Kwok, 2018: 28).

A conceptual framework was derived through inductive reasoning from the literature reviewed pertaining to this study, as such a framework can address several critical elements. This framework highlights problem areas in the water management environment at local government level, as became evident in the literature reviewed, and is discussed in greater detail in Chapter 2 of this study.

1.5 RESEARCH DESIGN

A qualitative descriptive approach was deployed as research design. Qualitative contexts and descriptive approaches are useful when researchers want to understand events, who and what were involved, and where things took place (Lambert & Lambert, 2012: 256). Qualitative research approaches provide a 'feeling' for context and choices made and enrich understanding of a concrete situation. Qualitative research may hold the potential to provide some answers to challenges – and perhaps provide contextual pointers to (re)solve problems.

Simultaneous data collection and analyses are characteristic of this process. In this research project, the researcher chose to remain within the ambit of this approach, since it was reckoned that this may lead to the exploration of possible solutions to current challenges at local government levels.

Data collection for this study took place by conducting an extended literature review pertaining to water security globally and nationally (the latter tapered down to local government level) until data saturation was achieved. Data was organised into subheadings (themes and sub-themes) to ensure a clear understanding of the subject matter.

South Africa is not unique in facing challenges related to water. Where applicable, the researcher uses insights gained from literature related to other cases from other countries or contexts reflecting comparative elements within the broader setting of this study. Where necessary, specific themes are identified, discussed and compared against the background of the current challenges within the parameters of the chosen research approach. Data saturation is reached when it becomes evident that new information to inform the study is no longer being obtained, and when further analysis of the problem under investigation is no longer feasible (Fusch & Ness, 2015: 1413). The body of literature consulted constitutes relevant academically acknowledged international and national publications that address the subject of water security, with specific reference to local government. Official documentation, such as reports or official communiqués, was also used. The sampling method used was non-probability sampling in the sense that available literature regarding the subject was studied until data saturation had been achieved (Burns & Grove, 1993: 244-247). Throughout the process of the research (the evolving nature of qualitative research is relevant here), the researcher remained open to new sources and insights that could enrich the study and its findings.

Bryman (2012: 714) defined content analysis as an approach to documents that focus on the role of the investigator in the development of the meaning of data and texts. The researcher allowed for groupings or themes to emerge from the data that had been collected (Bryman, 2012: 714). Recognising these groupings and categories revealed the significance of such categories, as well as the understanding and the meaning of the framework in which a construct was being analysed (and the categories derived from it), as will become evident in this dissertation.

1.5.1 Reliability and validity

It is well documented that all research should, as far as possible, provide evidence of reliability and validity. Fox and Bayat (2014: 144) defined qualitative validity as a measurement that represents what it is supposed to represent. In this study, validity is referred to in

qualitative research terms, i.e. the concept of “internal validity” (Fox & Bayat, 2014: 145). Alternative terms and ways to ensure reliability and validity in qualitative research were proposed by Lincoln and Guba (1985, as cited in Bryman, 2012: 390). For example, they endorsed trustworthiness as a criterion for the quality of a qualitative study. According to Bryman (2012: 49), these criteria are listed as credibility, transferability, dependability and confirmability.

Fox and Bayat (2014: 145) stated that the reliability of research results is concerned with characteristics such as dependability, consistency, accuracy and comparability of data. In addition to these four trustworthiness criteria, Lincoln and Guba, as cited in Bryman (2012: 393) suggested that criteria of authenticity be included in the aspect of trustworthiness of qualitative research. These criteria raise a broader set of issues concerning the more substantial dogmatic influence of research. These criteria of authenticity, according to Lincoln and Guba, are listed as fairness, ontological authenticity, educative authenticity, catalytic authenticity and tactical authenticity (Bryman, 2012: 393).

1.5.2 Significance of the study

Water (in)security has become part of a global phenomenon also evident in South and Southern Africa and in people’s daily lives. The aim of this study was to determine how the management practices of water resources at local government level can become such a threat to water security in South Africa that if not corrected or ignored, this threat would have the potential to affect the national security of South Africa adversely. Reflecting on such threats, this study aspires to develop recommendations to circumvent or at least minimise the threats. Therefore, water and food security were examined further in more detail as part of this study. While numerous studies have been and are still being undertaken in the field, this particular study may bring to the fore some insights that can complement other studies in search of a problem-solving approach. It may add further perspectives and insights on water management in the local government sphere and recommendations arrived at through the study may assist in alleviating current challenges.

1.5.3 Delimitations

Delimitations of this study exclude monitoring and evaluation indicators for the three tiers of government, especially local government, on water management, as this fell outside the scope of this study.

Water, food and human security are all interconnected and related to national security. In order to ensure that national security remains intact, this study stopped short of addressing the matter of whether water resources and the management of water resources should be securitised, as this fell outside of the scope of the study. The focus of the study remains improvement of the quality of service delivery through better management practices.

1.5.4 Assumptions and sources

The assumption was made that a literature study of articles in peer-reviewed journals, edited works, chapters in books, occasional papers and reports by think-tanks may elucidate the research questions and provide some fruitful insights. Commissioned research reports by various organisations locally and internationally, books, government reports and communiqués, statements by relevant authorities or spokespeople for local government and reputable internet sources were also consulted. Sources were aimed at ensuring internal validity and reliability of the findings in this study. The documents used fall in the public domain. These sources could provide significant insight into what can be regarded as inadequate management practices and identify recommendations to overcome the perceived threats at local government level in South Africa.

Exploratory and systematic reading, re-reading, comparison and reflection on these sources were aimed at ensuring internal validity and reliability of the findings in this study, without suggesting that the findings can serve as a panacea for all.

1.6 CHAPTER OUTLINE

This dissertation is divided into six chapters. Chapter 1 contextualises the study and sets the scene in terms of the research problem, the rationale for the study and the research objectives and research questions. This chapter concludes with the framework for the study.

Chapter 2 provides a comprehensive literature review on the water resources in South Africa, how these resources are managed and problem areas in their management. This formed the foundation of the study. The literature review includes literature such as books, chapters to books, journal articles, research reports, occasional papers from research think tanks, conference papers and proceedings and government reports on the subject under discussion.

Chapter 3 expands on the theoretical framework by using Fayol's management theory as a basis. Through the years, management theories have evolved and become more multi-faceted. This chapter expands on the theoretical and descriptive exploration research methodology that was used to analyse the data and identifies themes and sub-themes, supported by available literature to establish a connection between management theory and the current state of water management in South Africa. Elements of a descriptive methodology may be observed by the reader.

In Chapter 4, the results of data analyses are discussed and presented. Chapter 5 discusses the nexus between climate change, water security and local government. The important role of the municipality in mitigating the effects of climate change is explored. Aspects of future planning and the use of technology in early warning systems and drought planning are discussed in this chapter. The chapter concludes by looking at lessons learnt from the Cape Town Day Zero experience. Chapter 6 finally discusses pointers for future research and more important context-relevant recommendations.

1.7 CONCLUSION

Water is the source of life, the most precious and essential of all natural resources, without which human and non-human life cannot survive. In the process of analysing the management of water resources at local government level, the management practices of water resources and infrastructure are explored. The poor management of water resources could be seen as a threat to water security in South Africa. Water insecurity can lead to food insecurity, which in turn can spill over into human insecurity, ultimately posing a threat to national security.

Drought-proofing South Africa through accelerated infrastructure development, training and development of human capital at all levels of government is vital. Improving revenue collection at local government and national government level, will go a long way in securing South Africa's future. In doing so, local government was chosen as focus, as local government is seen as government closest to the people or communities.

In conclusion, this chapter serves as an orientation by stating the rationale for the study. A research problem has formulated, and the research questions have been stated. The objectives of this study were threefold, namely to:

- Identify and explore management factors at local government level that may have an adverse effect on water security.
- Identify and explore environmental factors that may have an adverse effect on water security if not planned for at local government level.

- Identify and explore possible steps to improve the current situation to ensure water security at local government level, through a literature review and analyses.

As already stated, Chapter 2 explores the problem through an extended literature study.

2

LITERATURE REVIEW

"We are the first generation that can end poverty – and the last generation to tackle climate change before it is too late" − Ban Ki-Moon, UN Secretary-General.

2.1 INTRODUCTION

In the last decade, the focus was on providing more South African families with safe, reliable drinking water and adding taps to previously marginalised homes and rural areas. In a way, since as far back as the announcement by the new post-apartheid government of the Reconstruction and Development Plan (RDP), this idea can perhaps be described as "bringing clean water to the citizens and the previously disadvantaged communities" in the country. Thereafter, despite this ideal, it seems that the South African government has lost some focus of the critical sources of its water and of the crucial role that the environment plays in ensuring water for all. Even though the water supply chain is critical, the engineered infrastructure will not supply water to the people unless care is taken of the country's river systems and dams, ecological catchments and aquifers (WWF-SA, 2013: 6).

The availability of water is a result of two different but inseparable processes. The first addresses water supply, relating to volumes of water that can be sustainably collected from land and sub-surface supplies and from alternative sources (WWAP (UNESCO World Water Assessment Programme), 2019: 147). These alternatives include desalination of seawater, re-use of wastewater, and rainwater and fog collection. Efficient water usage in all major water use sectors (farming, electricity generation, manufacturing, and municipal/domestic use) will go a long way in reducing total demand and thereby freeing up water sources for other purposes, including ecosystems. Equally important is water accessibility which involves the distribution of water from the source and making it available in adequate quantity and quality to different users (WWAP (UNESCO World Water Assessment Programme), 2019: 147).

South Africa's strategic water-source regions, often referred to as the 'crown jewels' of South Africa's water-sources, were mapped through the research conducted by the Worldwide Fund for Nature South Africa (WWF-SA) and the Council for Science and Industrial Research (CSIR). This joint venture has found that just 8% of the land surface area of South Africa

provides over half of the river flow. Such results make it clear that water does not derive from a tap (or dam) (WWF-SA, 2013: 6).

Careful planning and far-sighted intervention are needed to conserve this precious natural asset so that future generations can inherit a healthy environment and conserve water for South Africa and its people (WWF-SA, 2013: 6). The availability of fresh water is one of the main limitations of sustainable growth in South Africa. South Africa is a water-scarce country, with irregular precipitation spread across the region, associated with a seasonal cycle of rain and drought, feast and famine (WWF-SA, 2013: 7).

The South African freshwater ecosystems have been classified and divided into national freshwater ecosystem priority areas. Research has found that 60% of the country's river systems are under pressure, and 23% are in grave danger. Perhaps even worse is the wetland scenario: 65% of South Africa's wetlands are under pressure, and 48% are under extreme threat (WWF-SA, 2013: 10). The health of rivers and wetlands is determined by the diversity and health of the animals with which water systems and wetlands are shared. Water is a natural 'living' resource in which microbes, plants, and animals interact with water and related chemical cycles that determine how water can be used as a resource. Only healthy ecosystems provide clean and healthy water. In semi-arid countries such as South Africa, rivers are used as the lungs of living ecosystems (WWF-SA, 2013: 10). On the journey from the headwaters to the water users, water faces several obstacles. Pollution from fertiliser and wastewater runoff, as well as the effects of mining activities, add to the danger of poisoning rivers and streams. Excessive abstraction from surface and groundwater sources, as well as unnecessary losses from pipe leaks, threatens to destroy the essential resource, which can neither be replaced nor substituted. Coal can be replaced as an energy source by solar or biofuel power, but water cannot be replaced (WWF-SA, 2013: 10). As a water-scarce country, South Africa needs to act urgently to protect water resources and make the most effective and productive use of what it has. Public leadership, stakeholders and communities need to understand where water comes from, how to protect it from the source to the point of use, and how to avoid waste. To this end, the South African water cycle will require management of and investment in vital ecological and engineered infrastructure (WWF-SA, 2013: 10).

2.2 GEOGRAPHY OF SOUTH AFRICA

South Africa is the continent's most southerly country. A shoreline more than 3 000 km long connects the eastern and western coasts of South Africa. The country extends from north to south, and from east to west, occupying an area of 1.22 million km^2. Botswana and Zimbabwe border South Africa to the north, northeast and east, with Mozambique, Swaziland and the Indian Ocean to the southeast and south, the Atlantic Ocean to the south-west and

Namibia to the north-west. Lesotho, an independent constitutional monarchy, is surrounded by South Africa in the south-eastern part of the country (FAO UN, 2016: 1).

Figure 2.1 indicates the annual rainfall of South Africa. It depicts clearly that the western part of the country is drier than the eastern part.

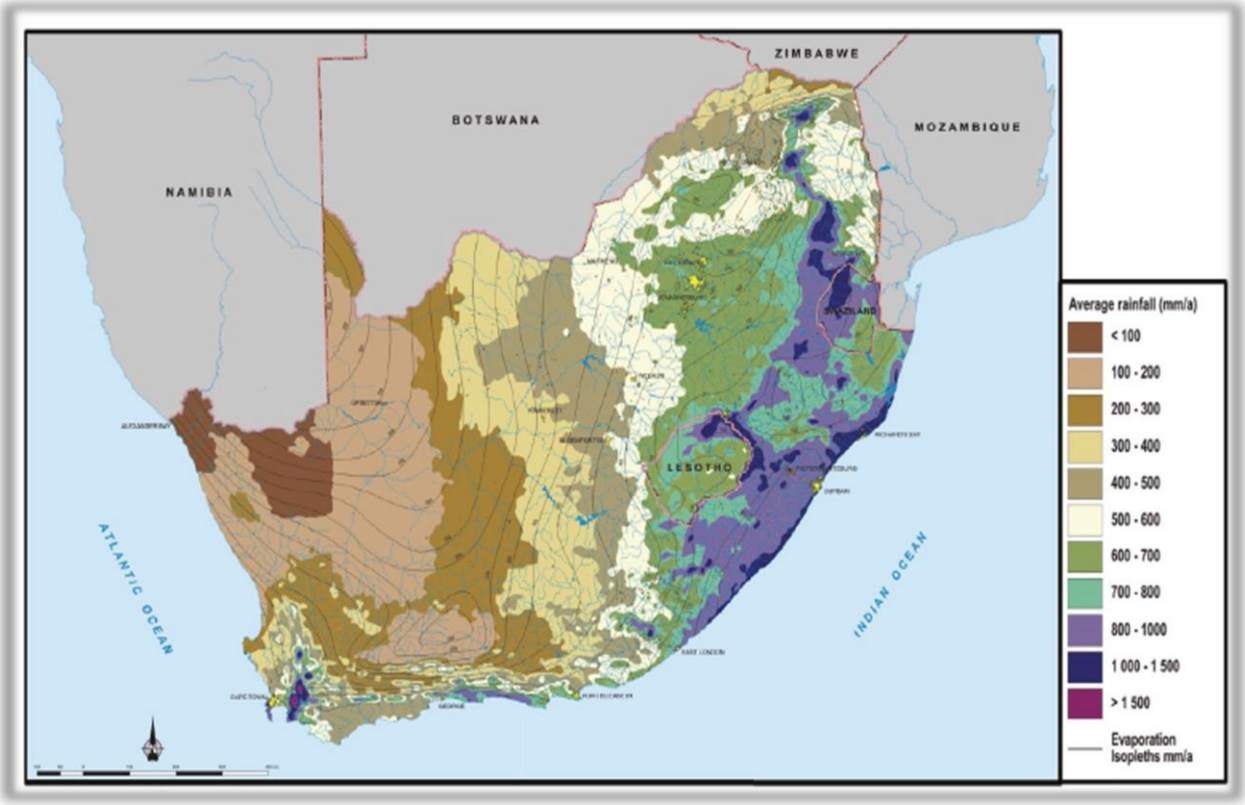


Figure 2.1: Average annual rainfall map of South Africa

Source: APP DWS (2018: 13).

The first stage of the water cycle is the point at which precipitation becomes river flow – that is, in the water source areas of South Africa. South Africa drains into the following four major systems (FAO UN, 2016: 3):

- The Gariep River rises in the Lesotho Highlands and drains approximately 48% of the country (606 000 km²) to the Atlantic Ocean, along with its tributaries, namely the Caledon River and the Vaal River. The total annual average runoff is 11 100 million m³.
- The Limpopo River Basin drains about 14% of the country from the plateau south of the Witwatersrand Ridge into the Indian Ocean with its tributaries, the Crocodile River and the Olifants River. This basin has an annual average runoff of 5 100 million m³. All other rivers, the largest of which is the Tugela River, drain into the Indian Ocean. They cover a total of around 29% of the country, with an average annual runoff of 28 000 million m³. The Olifants and Breede Rivers drain the Southwest Cape Fold Mountains into the Atlantic and Indian

Oceans, respectively. Combined, they cover a total of around 9% of the country, with an average annual runoff of 5 000 million m³ (FAO UN, 2016: 3).

The 19 water management areas (WMAs) established by the first National Water Resources Strategy (NWRS) were consolidated into nine WMAs, according to the hydrological catchment areas. These areas correspond to the nine regional offices of the Department of Water and Sanitation (DWS), as set out in the second NWRS. These nine WMAs are listed as follows: Berg Olifants, Breede Gouritz, Inkomati Usuthu, Limpopo, Tsitsikamma Mzimvubu, Olifants, Gariep, Mtamvuna Pongola and Vaal (DWS, 2014, as cited in FAO UN, 2016: 4).

These nine WMAs are indicated in Figure 2.2 below.

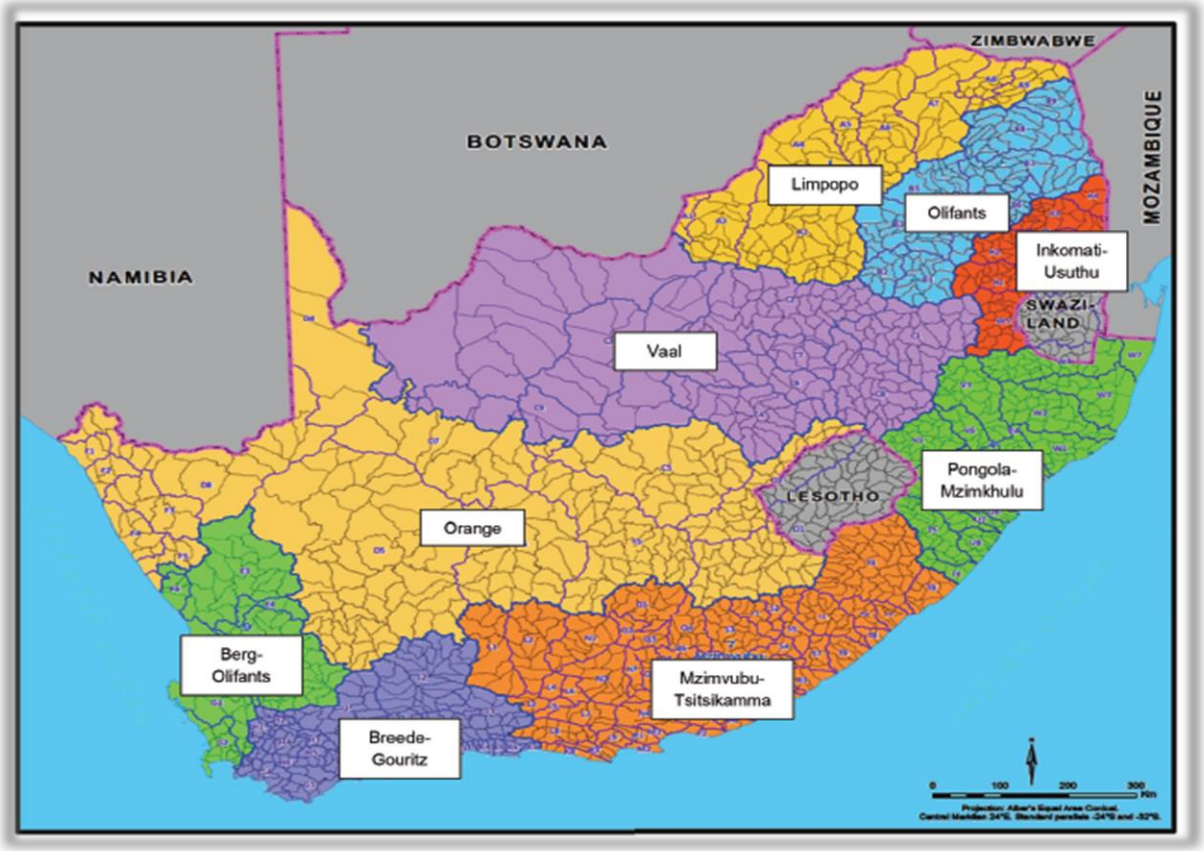


Figure 2.2: Water management areas in South Africa

Source: APP DWS (2018: 14)

2.3 WATER DEMAND AND PRECIPITATION

The average annual precipitation in South Africa of 465 mm (half the world average) produces an annual runoff of around 49 billion m³ per annum (m³/a). The total reliable surface water output at sufficient supply is approximately 10 200 million m³/a nationally. Approximately 70% of the amount is accumulated in the country's 252 biggest dams. The maximum capacity

of South Africa's domestic groundwater is about 4 500 million m³/a, of which 2 000 to 3 000 million m³/a are used at present (NW&SMP, 2018b: 6).

According to Hedden (2016: 4) and the NW&SMP (2018b: 6), agriculture is the largest consumer of water in South Africa at 62%, followed by municipal use at 27% (including municipal industrial and commercial users), with power generation, mining and large-scale industrial use, animal husbandry, conservation and afforestation consuming the remaining 12%. If demand continues to increase at present rates, a water supply deficit of between 2.7 and 3.8 billion m³/a is anticipated owing to population growth and economic development by 2030 (WWF-SA, 2016: 8; NW&SMP, 2018b: 6). Moreover, it is important to remember that South Africa's water resources are now almost entirely allocated. This means that new businesses and industries would find access to water licences increasingly difficult, particularly in more overdrawn catchments (WRC, 2015: 1).

In South Africa, on average, every person uses 64 litres more water per day than the average per person worldwide (NW&SMP, 2018b: 7). South Africa uses approximately 237 litres of household water per day per person. It is alarming to note that the Water Research Commission in its Annual Report for the Financial Year (FY) 2017/18 stated the following:

> Increasing water scarcity has placed water as the biggest societal and economic risk for the next ten years. Most risks are global and have the potential to cause significant negative impact across entire countries and industries (Annual Report Water Research Commission, 2017: 28)[1].

Water will not only become a problem in South Africa over the next ten years but will be under threat throughout the world. South Africa should be vigilant to speed up its plans to drought-proof the country because it is forced by climate change to look at water differently for survival in the future. The UN Report (2006: 74) is correct to state: “It can’t be business as usual”.

Although the municipal sector is expected to account for most additional withdrawals, water demand is forecast to increase in all three sectors (municipal, industrial and agricultural). In absolute terms, municipal water demand is forecast to increase by 1.3 km³, industrial demand by 0.2 km³, and agricultural demand by about 0.5 km³ from 2017 levels by 2035 (Donnenfeld, Crookes & Hedden, 2018: 8).

[1] An analysis of the situation in the Western Cape Province indicates that the water crisis of 2017/2018 was an example of the careless overuse of water that exacerbated the crisis before mass-communication programmes convinced the population to use less water. If this did not happen, Day Zero was a strong possibility.

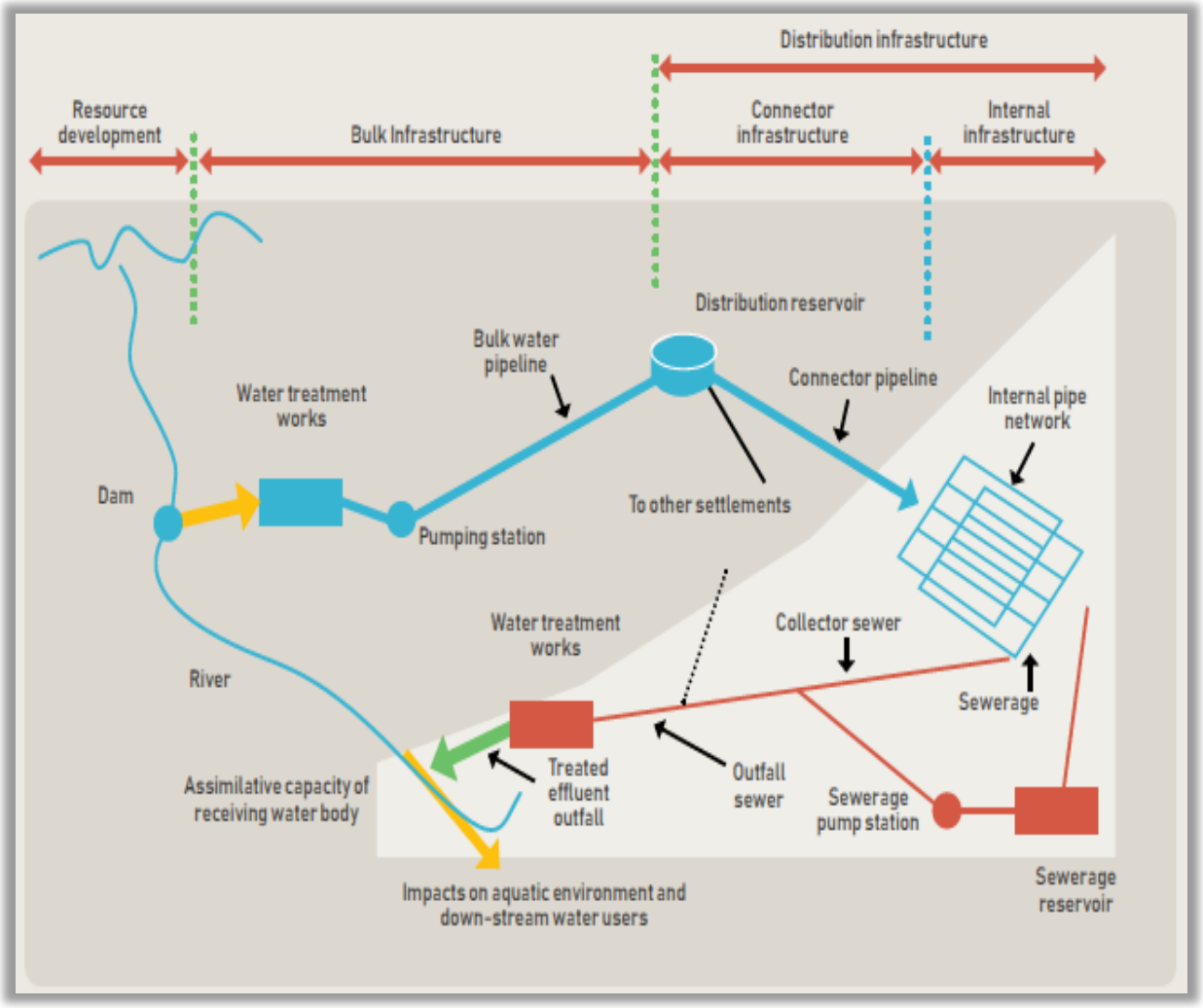


Figure 2.3: Engineered infrastructure of South African water systems

Source: WWF-SA (2016: 35).

2.4 OVERVIEW OF SOUTH AFRICAN WATER CAPABILITIES

The figure below is a visual display of the process of managing water from precipitation and catchment to consumption, and the anticipated deficit by 2030.

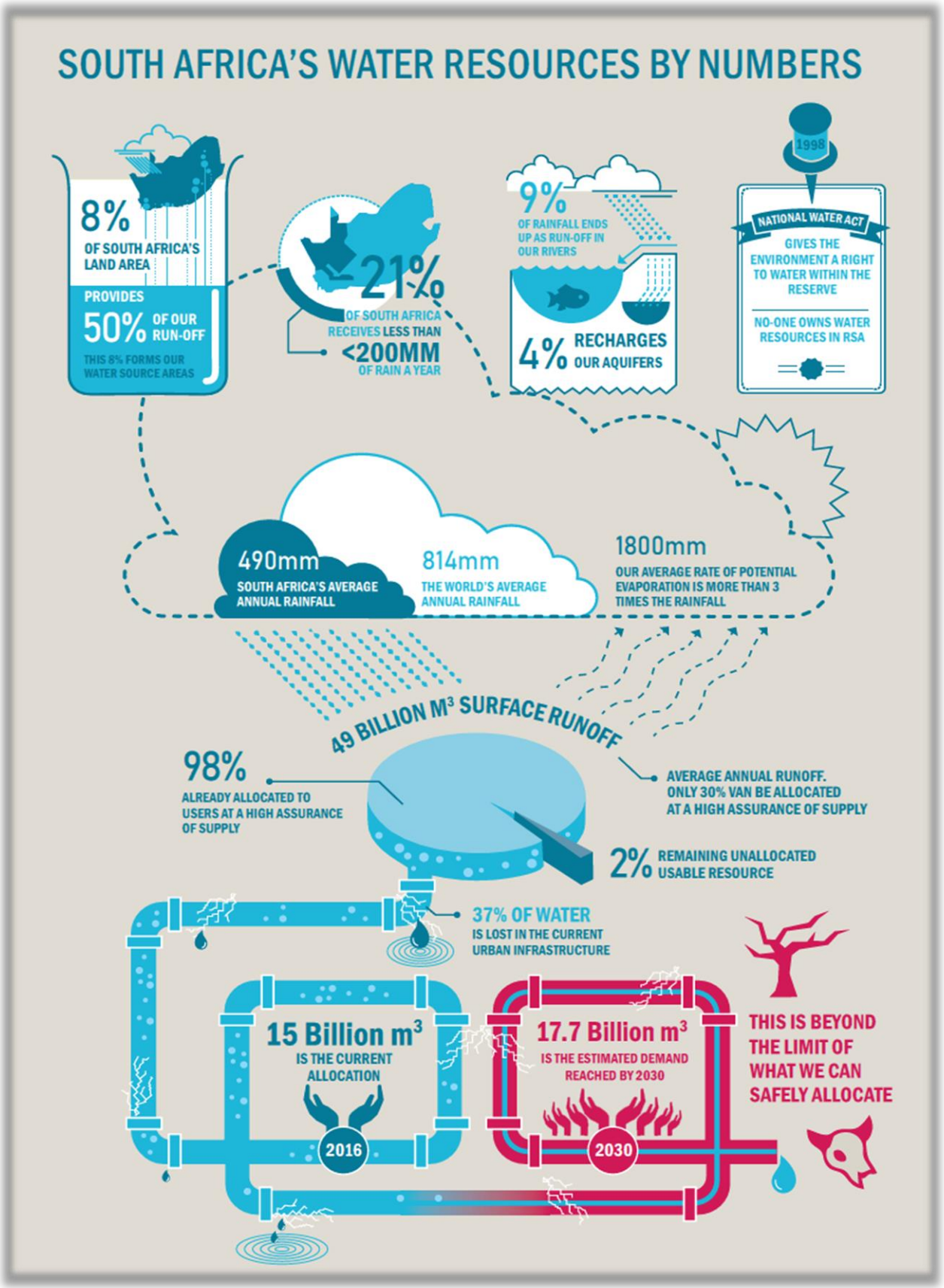


Figure 2.4: Water resources water systems: Surface water and groundwater

Source: WWF-SA (2016: 13).

2.4.1 Origin of South Africa's Water

Freshwater resources in South Africa are classified into three sources: surface water, return flows and groundwater, at 77%, 14% and 9% respectively. Groundwater is the primary resource for domestic use in many rural areas but constitutes a small proportion of the total resources on a national scale. As adaptation approaches to optimise the use of surface water are more difficult to enforce, groundwater should act as a significant safeguard as South Africa tries to diversify its resource base (Department of Science and Technology, 2010: 22).

The WWF-SA conducted research in conjunction with the CSIR to evaluate the source of most of South Africa's water. Through modelling data on rainfall and flow of water, the study found that only 8% of the land surface area generates as much as 50% of the surface flow (WWF-SA, 2013: 14). Downstream users and ecosystems depend on the safe and efficient functioning of water source areas (WSAs) to maintain good water quality downstream (WWF-SA, 2013: 14).

WSAs in South Africa can be split into WSAs of local and national significance. Five WSAs are local, but their downstream reliance and effect are restricted. They are primarily on the coast of the Western Cape and KwaZulu-Natal (KZN) (WWF-SA, 2013: 14). The 16 strategic WSAs come from the headwaters of major river systems providing large amounts of water to regions and economies downstream, including cross-basin transfers. It is interesting to note that from a strategic point of view, disrupting water supplies from these 16 strategic WSAs would effectively shut down South Africa's economy and have a significant effect on the country's food and water security (WWF-SA, 2013: 14).

Table 2.1: The 16 strategic WSAs of South Africa as adapted from WWF-SA (2013: 15)

Water Source Area	Main Rivers	Threats
Grootwinterhoek	Olifants River; Klein Berg; Doring	Land degradation; climate change; alien invasive vegetation; fires
Table Mountain	Hout; Diep	Climate change; alien invasive vegetation; fires
Boland Mountains	Berg; Breede; Riviersonderend	Large-scale plantations; land degradation; climate change; alien invasive vegetation; fires
Outeniqua	Groot Brak; Olifants	Large-scale plantations; alien invasive vegetation; fires
Kougaberg	Kouga; Baviaanskloof; Olifants; Gamtoos; Gouritz	Climate change; alien invasive vegetation; fires
Amatole*	Great Kei, Keiskamma, Great Fish,Tyume; Amatele.	Land degradation; fires; alien invasive vegetation
Eastern Cape Drakensberg	Mzimvubu; Gariep; Bokspruit; Thina; Klein Mooi; Mthatha	Land degradation; fires; climate change
Maloti Drakensberg	Caledon; Gariep; Senqu	Large-scale cultivation; land degradation
Northern Drakensberg	Senqu; Caledon; Thukela; Gariep; Vaal	Coal mining; land degradation

Water Source Area	Main Rivers	Threats
Southern Drakensberg	uMngeni; Mooi; Thugela; Mkomasi; uMzimkulu	Large-scale plantations; land degradation
Mfolozi Headwaters	Lenjane, Black Mfolozi; Pongola	Large-scale plantations and cultivation; coal mining land degradation
Enkangala Drakensberg	Pongola; Bivane; Assegaai; Vaal; Thukela; Wilge	Coal mining; large-scale plantations; land degradation
Mbabane Hills	Usutu; Lusushwana; Mpuluzi; Inkomati, Pongola	Large-scale plantations; land degradation
Mpumalanga Drakensberg	Elands; Sabie; Crocodile; Olifants	Large-scale plantations; coal mining; land degradation
Wolkberg	Middle Letaba; Ngwabitsi; Oliphants	Large-scale plantations; land degradation; climate change
Soutpansberg	Luvuvhu; Little Letaba; Mutale; Mutamba; Nzhelele	Large-scale plantations and cultivation; land degradation

2.4.2 Surface water

About 4 718 dams are registered with the South African Dam Safety Office, including those owned by the DWS as well as private owners. The DWS has 305 dams containing 29.2 billion m³ of water. This constitutes 70% of the country's overall dam capacity. Gariep Dam on the Gariep River between the Eastern Cape and Free State is South Africa's largest DWS-owned dam with a capacity of around 5 500 million m³ water (WWF-SA, 2016:36). In an area-supplying scheme, many dams and other services are merged, such as the Integrated Vaal River System (IVRS) to provide water to Gauteng, SASOL's petrochemical industries and the ESKOM power stations in Mpumalanga[2] (NW&SMP, 2018a: 3-9). Most of the surface water that can be used reliably has been allocated, so future growth in storage and supply will need to come from underground. It has been proven that managed aquifer recharge offers an evaporation-proof means of ‘water banking’. Some towns are already using this technology. This will be a critical element of a water-secure future for many towns and cities (WWF-SA, 2016:3)

2.4.3 Importance of groundwater

As adaptation strategies focused on infrastructure to maximise the use of surface water become more challenging to implement, groundwater will serve as an essential safeguard as

[2]South Africa has a combination of pumped-water storage systems and small hydroelectric stations. Pumping uses some electricity, though this occurs at off-peak hours. The water is released through a turbine that drives an electric generator during peak hours when extra electricity is required. Usually peak hours are from 06:00 to 08:00 and 18:00 to 20:00. Some provinces have the potential to generate electricity through small hydroelectric power stations of less than 1 MW. These plants can be either stand-alone or in hybrid combination with other renewable energy sources. Benefit can be extracted from the combination of certain water uses – such as water supply, irrigation and flood control – which would be key to sustainable growth and socio-economic progress in South Africa (GCIS, 2019b: 9-10).

South Africa looks to diversify its resource base (Department of Science and Technology, 2010: 22).

Historically, groundwater has taken a rear seat, as the production of large-scale water infrastructure in South Africa has dominated surface water resources. This is no longer the case, and groundwater is increasingly becoming the primary water source on multiple levels, from smaller-scale sources, such as boreholes, to sophisticated supply systems (WWF-SA, 2016: 45). Groundwater is also a prospective buffer during drought because significant amounts of water can be stored in underground aquifers. Because the surface water dam storage capacity is usually many times greater than the average annual runoff in the catchment areas, it is of interest to note that by comparison, an aquifer can hold many thousands of times more water than the annual recharge (WWF-SA, 2016: 45). This stored volume is not subject to water loss due to evaporation, either. For an aquifer already heavily used, additional stored quantities during drought (if the short-term impacts are acceptable) can be acquired and replenished in the subsequent non-dry years through the controlled decrease of abstraction (WWF-SA, 2016: 45).

2.4.4 Managed aquifer recharge

The active injection or addition of water into aquifers is intended to capitalise on aquifers as large storage facilities (WWF-SA, 2016: 47). The then Ministry of Water and Forestry released its first *Artificial Recharge Strategy* in 2007. It had a definite view of maximising the use of natural subsurface storage capabilities where this could be achieved technologically and economically in an environmentally and socially viable way (DWAF, 2007, as cited in WWF-SA, 2016: 47). Municipalities, farms or facilities that use artificial recharge are effectively banking water and are better shielded from dry periods and droughts through this process. In areas where infiltration is beneficial, the potential volume of artificial recharge may exceed 100 000 m^3/km^2. For example, the DWS estimated that, at an average drawdown of 5 m, groundwater availability is 397 million m^3 per year, increasing to five times as high to 2 000 million m^3 per year if the potential artificial recharge volume is used (WWF-SA, 2016: 47).

South Africa's realistically usable groundwater potential is approximately 4 500 million m^3/a of the total sustainable potential groundwater output of roughly 7 500 million m^3/a, spread throughout the country (NW&SMP, 2018a: 3-11). Actual groundwater use at present is estimated to be between 2 000 and 3 000 million m^3/a. Most groundwater infrastructure has been developed and maintained by municipalities to supply household water. "Intentional charging of the aquifer with waste or waste-containing water" was permitted by 1998 (South Africa, National Water Act 1998). Since the artificial recharging process almost always alters the aquifer's water quality, this should only be permissible if the water quality can be proven.

Atlantis (north of Cape Town) and Polokwane currently have two artificial recharge schemes, using treated wastewater for groundwater recharge. Two licences were also issued in recent years to drain the aquifer for mining purposes and to recycle abstracted water at another site (by injection), at the Kolomela Mine near Postmasburg (Northern Cape) and Elandsfontein Mine near Saldanha (Western Cape) (Muller, Schreiner, Smith, Van Koppen, Sally, Aliber, Cousins, Tapela, Van der Merwe-Botha, Karar and Pietersen, 2009: 22; NW&SMP, 2018a: 3-12).

2.4.5 Interbasin transfer management

Interbasin transfers (IBTs) or diversions are conveyance (man-made) schemes that move water from one river basin where it is available to basins with less available water. Figure 2.5 below is a depiction of the magnitude of IBTs in South Africa.

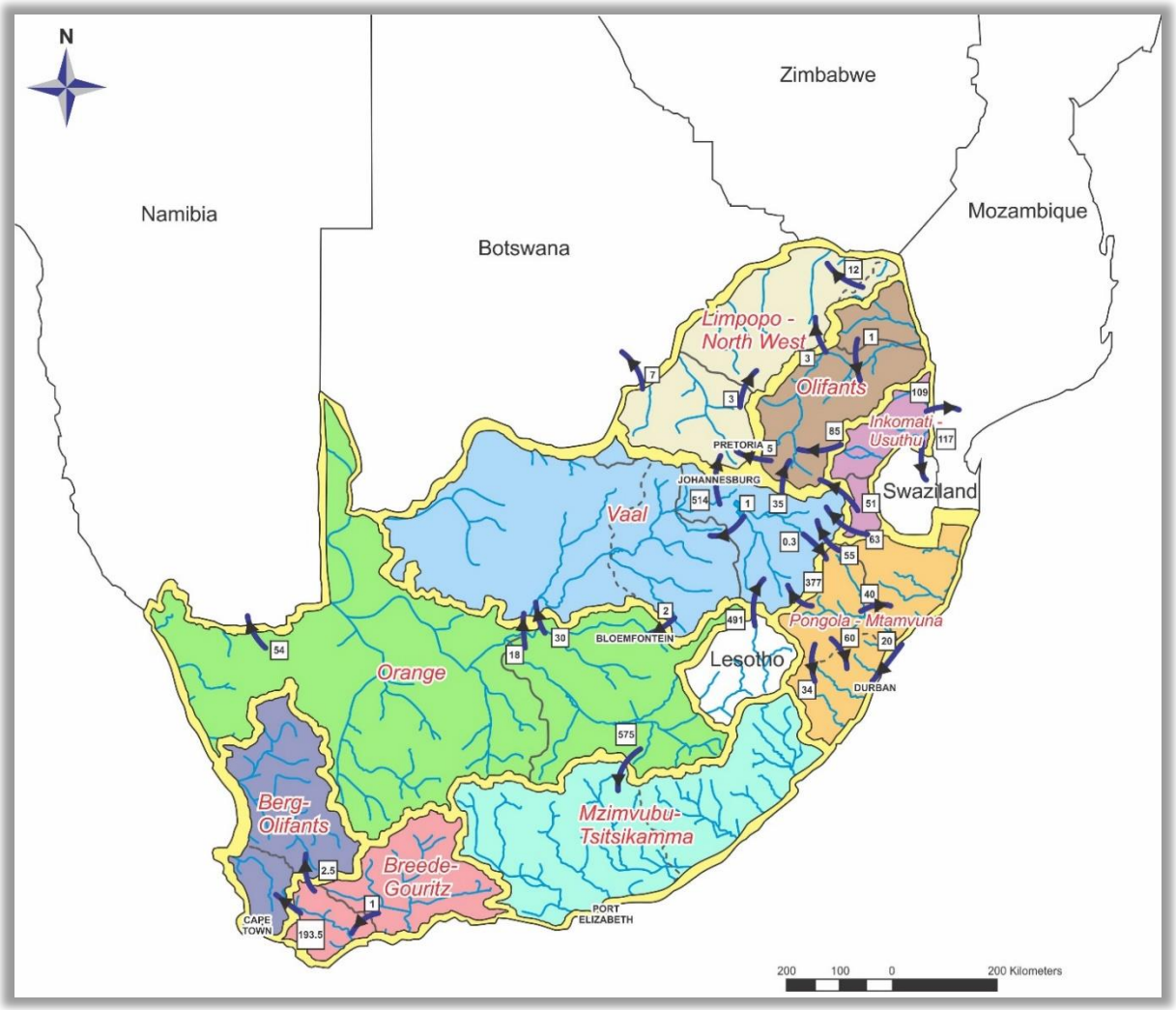


Figure 2.5: Depiction of the magnitude of interbasin transfers

Source: NW&SMP (2018a: 3-10).

One unique feature of South African water management is that around 3 000 million m^3/a water is transferred to water-poor areas of the country where supplies are more significant than the in-basin requirements. This is achieved through approximately 30 IBT systems. The aim of water engineering, where necessary, is to ensure a sustainable water supply when required (WWF-SA, 2016: 35). In abstract terms, IBTs are seen as the connection between spatial and temporal changes in precipitation and spatial variations in population distribution and economic activities (Turton & Henwood, 2002: 240). The development of IBTs was mainly motivated by the need to satisfy water demand for economic activities far from water resources such as metropolitan areas and large towns (WWF-SA, 2016: 35).

South Africa's significantly seasonal precipitation implies that it is critical to store water throughout the year. Dams and IBT systems are the cornerstones of engineered or hard water infrastructure. To get water to taps and sanitation from bulk water supplies, it is critical to have smaller infrastructures to deliver the water to urban, irrigation and wastewater systems. Dams provide more consistent flows and less flooding throughout the year (WWF-SA, 2016: 35).

The use of water for economic activity is a strategic issue within a given political economy. It is central to the problem of future water supply and demand at local government level. According to Turton and Henwood (2002: 240), inter-basin transfers also pose a strategic challenge to South Africa's future in the South African region owing to the uneven distribution of precipitation concerning the spread of the population and development needs. As a result, IBTs will become more strategically important in South Africa in the future, connecting river basins, states and political economies, possibly across international boundaries (WWF-SA, 2016: 39).

Similarly, transboundary flow means that South Africa shares water with neighbouring countries. South African river systems account for a total of 60% of the flow from or to a different country. The Gariep-Senqu Rivers headwaters are in Lesotho, and the tributaries flow from Swaziland into the Pongola River. The Limpopo and Inkomati Rivers cover Mozambique (WWF-SA, 2016: 8). A primary cross-border resource shared with Botswana and Namibia is the Kalahari Karoo aquifer. Under the National Water Act (South Africa, 1998b), South Africa has an international responsibility to ensure that river flow is managed across boundaries in a sustainable manner (WWF-SA, 2016: 8). This ensures that water systems have enough water to support them, which in effect helps to conserve the living resources on which people rely for their survival. This water is called an environmentally friendly reserve (WWF-SA, 2016: 8).

The Limpopo and Inkomati Rivers river basins, as well as the Pongola, Maputo and Gariep river basins, constitute approximately 60% of the South Africa’s land area. South Africa has four common international river basins. International river basins account for 45% of the

country's overall fluvial flow, supplying water to nearly 70% of gross domestic product (GDP) and sustaining 70% of its population (NW&SMP, 2018a: 3-12).

As a vivid example, under the auspices of the Southern African Development Community (SADC), South Africa has concluded several cooperation agreements with relevant riparian states on sub-regional integration, under the *Revised Protocol on Shared Water Courses* (Turton et al., 2006, as cited in WWAP, 2012: 646; NW&SMP, 2018a: 3-12):

- The LHWP, comprising dams, tunnels and pipelines for water transfer from rivers in Lesotho to the Vaal catchment area in South Africa.
- The Komati River Development Project, currently involving the Maguga and Driekoppies Dams for water storage, mainly for irrigation in Swaziland and South Africa.
- Noord-Oewer Irrigation Project, using South African infrastructure for a development in Namibia.
- The Barberton Water Supply Project, drawn by Swaziland for water supply in South Africa from the Lomati river.
- Phongolo Poort Dam, where Swaziland has given South Africa storage services.
- The Gaborone Water Supply Project, which transports water from South Africa to the Botswana capital (WWAP, 2012: 646).

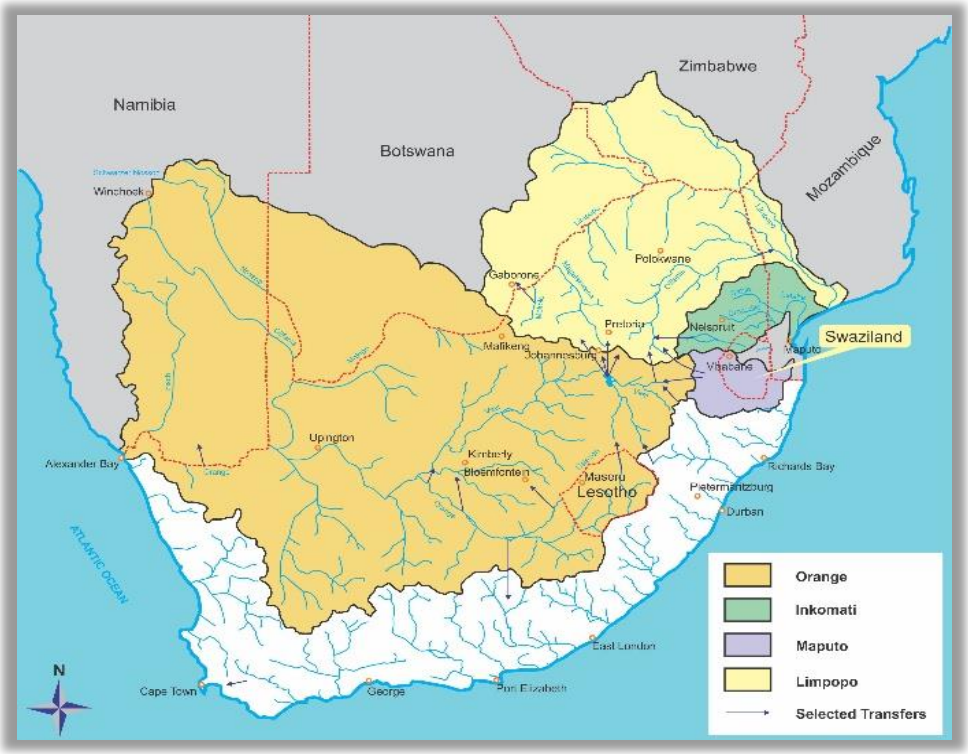


Figure 2.6: International surface water in South Africa

Source: The Source: International context of surface resources in RSA as adapted from the National Water and Sanitation Master Plan (2018a: 3 -12).

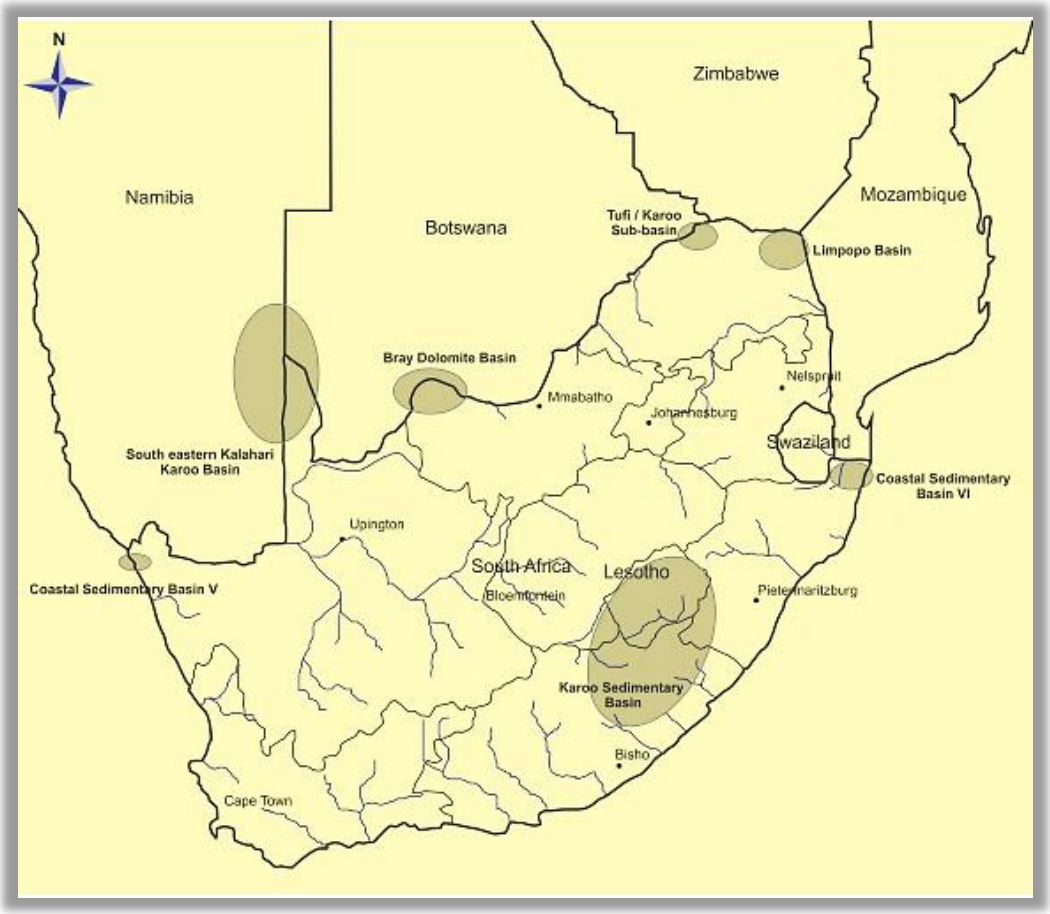


Figure 2.7: International groundwater in South Africa

Source: The International context groundwater resources in RSA as adapted from the National Water and Sanitation Master Plan (2018a: 3 -12).

2.4.6 Lesotho Highlands Water Project

The LHWP was established as a bi-national project across the border between South Africa and Lesotho according to the 1986 water agreement. This agreement ensures that water is delivered to South Africa, and in return, hydroelectricity is supplied to Lesotho (WWF-SA, 2016: 39). The LHWP is an impressive engineering feat, as it diverts water from the Senqu River system in Lesotho to the water-stressed economic hub in Gauteng province in South Africa. This transfer system's value is expressed in the fact that 40% of the Vaal River comes from Lesotho (WWF-SA, 2016: 39).

According to the Food and Agriculture Organisation (FAO) UN Report (2016: 5), this 34-year old scheme includes the Katse and Mohale Dams in Lesotho and more than 200 km of tunnels that divert water from the Upper Gariep River Basin in the Lesotho Highlands. This is done to supply another substructure of 780 million m^3 of water per annum to the Vaal River Basin to ensure water supply to the Pretoria-Witwatersrand-Vereeniging area. Phase 2, which

was agreed on in 2011, aims to increase the volume of water that will eventually be supplied to South Africa (DAFF, 2015, as cited in FAO UN, 2016: 5).

The LHWP, a multi-purpose undertaking, transfers 780 million m^3 of water to Muela Power Station and produces 72 megawatts (MW) of hydropower. In 2010 the revenue from the sale of raw water was over R2 708 million (WWF-SA, 2016: 39). Phase Two of the LHWP is called the Polihali Dam Project. The Polihali Dam is situated downstream from the Khubelu and Senqu Rivers. The Lesotho Gariep-Senqu tributary will be extended and strengthened by constructing the Polihali Dam (LHWP Phase 2). The LHWP has been identified as the cheapest option to meet the increasing demand for water in Gauteng in the future (Groves, Mao, Liden, Strzepek & Lempert, 2015:164, Du Plessis, 2019).The added construction of this dam, which should have been completed by 2018, will ensure enough water for Gauteng until 2030 (Muller, Schreiner, Vermeulen, Reddy & Maree, 2018: 2). Delays in preparation and construction mean that it will only be completed early in 2026 and will then rely on good rainfall to fill it up. Until then, Gauteng will become much more vulnerable to water restrictions if there is a prolonged drought (which is probable).

2.5 GOVERNANCE

Governance informs policy, which in turns informs rules and regulations**.** To understand the role and function of local government in water management and water supply to the people, the Constitution of South Africa becomes the cornerstone of governance. The role and responsibilities of local government are derived from national policy and legislation.

2.5.1 The Constitution of the Republic of South Africa (Act 108 of 1996)

Water security in South Africa starts with the Constitution. Water is an essential human right, as clearly stated in the Bill of Rights (South Africa, Constitution of SA Act, 1996: 13):

“Health care, food, water and social security. -

(1) Everyone has the right to access

(a) health care services, including reproductive health care.

(b) adequate food and water” (South Africa, Constitution of SA Act, 1996, art 27).

Access to water was one of South Africa's defining racial divisions pre-1994. After the demise of apartheid, a rights-based regulatory structure and government policies endeavoured among others to improve access to water to the people through the empowerment of local municipalities. They decreased disparities in South Africa (United Nations Development Programme, 2006: 64). This constitutional right was given in compliance with the Water Services Act (South Africa, 1997) and the National Water Act (South Africa,

1998b). These two acts gave citizens recognition and a sense of entitlement to hold municipalities, private businesses and national government accountable. Inevitably, in the light of disputes over water supplies, costs and the correct threshold for free water supply, the human right to water remains a contested field in South Africa. However, what is crucial is how human rights legislation gives citizens a true voice in water policy (United Nations Development Report, 2006: 101).

The Constitution of South Africa (Act 1996, art 24) states: “Everyone has the right to an environment that is not harmful to people's health and well-being, and to protect the environment, with appropriate legislation and other measures for the benefit of present and future generations:

- Preventing pollution and degradation of the environment
- encouraging conservation and
- ensuring environmentally viable growth and natural resource utilisation while fostering justified social and economic growth” (Water Shortage SA & OUTA, 2019: 9).

2.5.2 The National Water Act (Act 36 of 1998)

The objective of the National Water Act (South Africa, 1998b) is to ensure that South Africa’s water resources are protected, used, developed, conserved, managed, and controlled sustainably and equitably, for the benefit of all persons (Annual Report WRC, 2017b: 19). According to the National Water Act (South Africa, 1998b, art. 109), the DWS is also responsible for controlling and managing water resources, including the development of bulk water sources from networks that stretch outside municipal jurisdictions. It also allocates bulk water supplies and controls the protection and use of water resources throughout South Africa (Muller et al., 2018: 15).

The National Water Act (South Africa, 1998b) makes provision for the following:

- Catchment management agencies (CMAs) are institutions established by the Minister in terms of the National Water Act (South Africa, 1998b, as cited in Muller et al., 2018: 15). The intention expressed in the Act was “to delegate water resource management to the regional or catchment level and to involve local communities, within the framework of the national water resource strategy”. In terms of the Act, a CMA “may be established for a specific water management area, after public consultation, on the initiative of the community and stakeholders concerned. In the absence of such a proposal, the Minister may establish a catchment management agency on the Minister's initiative” (WWF-SA, 2016: 7, Muller et al., 2018: 15).

- Water boards are regulated public utilities, listed under the Public Finance Management Act (PFMA) as 'National Business Enterprises' and established and supervised by the Minister of Water and Sanitation. The Minister determines their areas of operation and can advise the water boards to take on different roles. Their primary function is to provide bulk water supply (and, more frequently, regional sanitation), where services need to cross municipal boundaries. In the context of Gauteng, Rand Water is by far the most significant, while Magalies Water supplies some water to the Tshwane area (Muller et al., 2018: 15).
- The Trans Caledon Tunnel Authority (TCTA) was established in 1996 by the Minister of Water Affairs as a special purpose mechanism for the construction of the South African portion of the LHWP. As a 'major public body' in terms of the PFMA, the TCTA is headed by the Minister of Water and Sanitation, who is empowered to provide clear direction and expected outcomes. Under a new Notice of Regulation (South Africa, NW Act, 1998, as cited in Muller et al., 2018:15), the TCTA has evolved as a multi-purpose vehicle to function as a funder and implementer of large-scale and limited-scale water supply schemes and has effectively initiated many big projects. It remains responsible for raising and managing the funding for the various phases of the LHWP (Muller et al., 2018: 15).
- In addition, the DWS is responsible for planning, constructing and maintaining the regional water supply networks that cross municipal and provincial borders. In this sense, it is strategically responsible for the IVRS and must ensure its planning framework is consistent with that of other sectors and institutions in the Gauteng region (Muller et al., 2018: 15).

2.5.3 The Water Services Act (108 of 1997)

The objective of the Water Services Act (South Africa, 1997) is to provide for the right of access to basic water supply and basic sanitation by setting national standards and norms (Annual Report WRC, 2017b: 19). The Department of Human Settlements, Water and Sanitation (DHSW&S) is responsible for the production, operation and maintenance of national water resource infrastructure, as well as various other government water schemes, including irrigation schemes. This includes the regulatory framework, as well as financial and technical support and supervision for the operation of water services functions of municipalities under the Water Services Act, Act 108 of 1997(South Africa, WS Act, 1997, art. 4,6,7).

The Water Services Act (South Africa, 1997) stipulates the obligation of municipalities to supply water and sanitation following national standards and norms (FAO UN, 2016: 13). The constitutional obligation of the local government for water falls under the WSA. As far as the Act is concerned, a municipality may be appointed as a water service authority (WSAU). This step guarantees access to water facilities for its municipal and metropolitan region but does not imply that it must also be the water service provider (WSP) (Water Shortage SA and

OUTA, 2019: 11). Where practical or essential for any other good purpose, they can appoint WSPs and water service intermediaries (WSIs) as their 'agents' to provide water on their behalf, but they may not abdicate their legislative responsibilities. In other words, the Water Services Act (South Africa, 1997) must ensure that the WSPs and WSIs provide the service they are contracted to perform (Water Shortage SA and OUTA, 2019: 11).

Metropolitan and local municipalities are responsible for the provision of water and sanitation facilities under the Constitution as well as the Water Services Act (South Africa, WS Act, 1997, as cited in Muller et al., 2018: 16), and nomination as WSAUs by Cooperative Governance and Traditional Affairs (CoGTA). These metropolitan and local municipalities are responsible for a range of related infrastructure and urban planning and management functions. Municipalities are also responsible for the overall planning and growth of urban land use, including densification issues, new residential and industrial projects and stormwater management (Muller et al., 2018: 16).

Municipal authorities are created by municipalities to provide certain services for or on behalf of municipalities. Johannesburg Water was founded in Gauteng as a WSP owned by the municipality but run under an independent board, while the East Rand Water Care Company is a specific specialised utility focused on East Rand wastewater treatment, now primarily within the municipality of Ekurhuleni (Muller et al., 2018: 16)

2.6 DEPARTMENT OF HUMAN SETTLEMENTS, WATER AND SANITATION

2.6.1 Mandate of Department of Human Settlements, Water and Sanitation

The legislative mandate of the DHSW&S is intended to ensure that water resources in the country are sustainably protected, managed, used, developed, conserved and controlled to the benefit of all people and the environment (South Africa, 2017: 2).

Given the DWS's fiscal constraints, the structure of the DHSW&S needs to ensure that the key problems identified in the mandate are focused and prioritised. These are as follows:

- Delivery of water resource infrastructure on time;
- Better planning and management of water demand;
- Ensuring water quality improvement and preservation of the ecosystem;
- Driving water supply and hygiene matters; and
- Conducting the delivery of water and sanitation services and addressing water and sanitation backlogs (APP DWS, 2018: 28).

In brief, the DHSW&S controls the abstraction and use of water (and the release to the environment of wastewater treated to an appropriate standard before release). The DHSW&S

is also responsible for reviewing applications and licences and setting down the conditions for abstraction and wastewater discharge (DBSA, 2016:17-18). As part of its resource planning role, it is the duty of the DHSW&S to determine the demands imposed on every water resource by the range of its users and to explore ways of reconciling accessible resources with demands.

The DWS also has institutional responsibility for the development and maintenance of national water resource infrastructure. The strategy followed at resource level is to prepare each supply system for the worst-case scenario (high demand, high level of supply assurance) and then schedule the execution of investments and other measures in accordance with the real nature of demand and resource variability (DBSA, 2016: 18).

Figure 2.8 on the next page indicates the complexity of water management in South Africa and the relationship between the Constitution, legislation, the DWS, the provincial government and the role of local government.

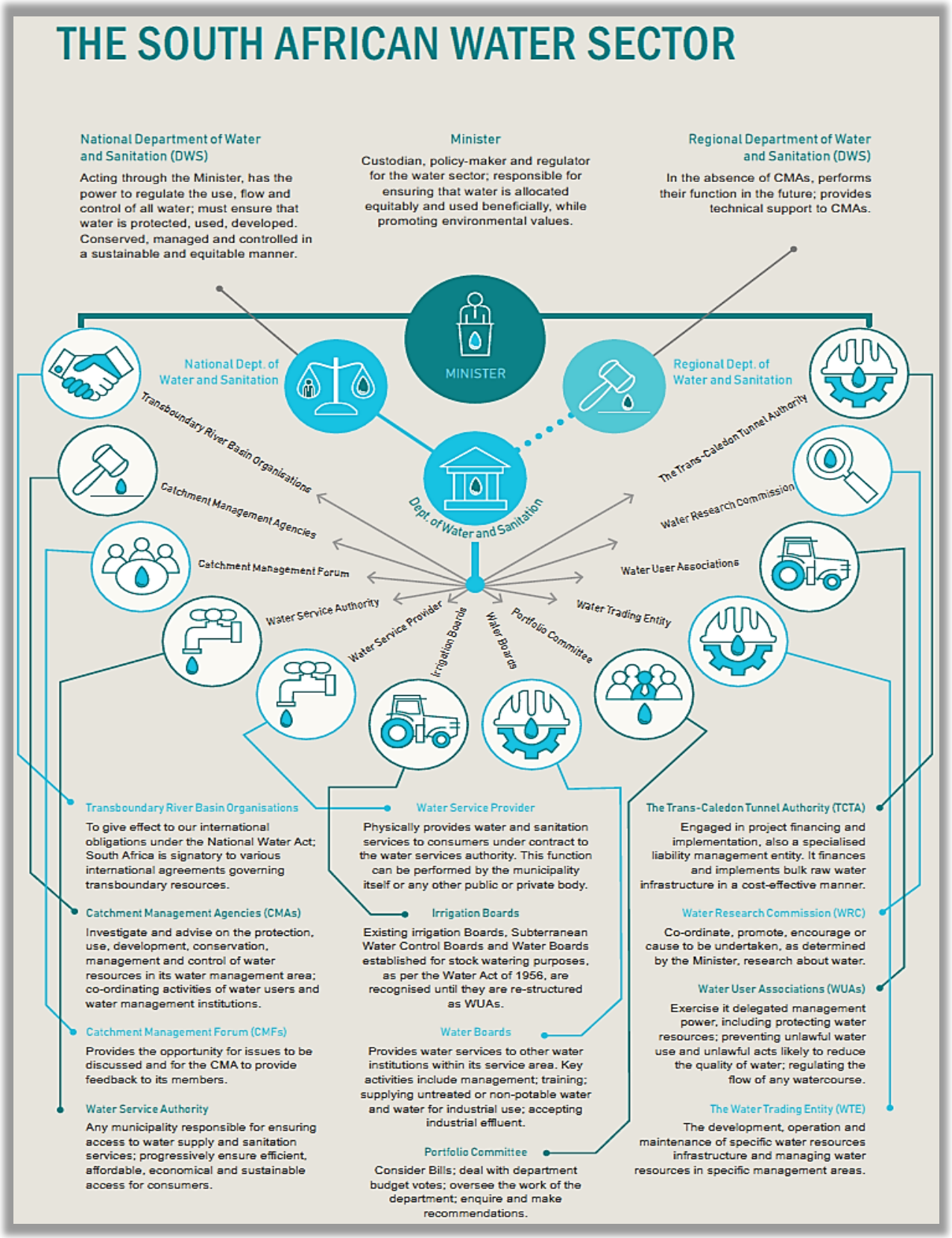


Figure 2.8: The South African Water Sector

Source: The South African Water Sector as adapted from WWF-SA (2016: 86).

2.7 THE ROLE OF LOCAL GOVERNMENT IN WATER PROVISIONING AND SANITATION

As stated earlier, the provincial government must support municipalities in carrying out their tasks. Article 139 (South Africa, Constitution of SA Act 1996: 58-59) of the Constitution gives the provincial government the responsibility to act where the local government does not provide services. In particular, the 2001 White Paper on Basic Household Sanitation notes that provincial governments play an essential role in helping communities to advance their agenda and to ensure successful operation of municipalities by providing financial, human and technical support to municipalities (SAHRC, 2014: 28).

In compliance with the Water Services Act (South Africa, 1997), local municipalities have the legislative responsibility to provide drinking water and domestic sanitation services as an appointed WSAU and to use the WSP to deliver services in accordance with the Water Services Act (NW&SMP, 2018a: 9-1). The South African Human Rights Commission (SAHRC) (2014:29) states that while responsibility for water resource management falls under the authority of the DWS, it is the duty of the local government or municipality to provide household water. The Water Services Act (1997) describes a WSAU as responsible for ensuring that every municipality, including district or local municipalities, have access to water. The WSAU is required to ensure that every consumer or prospective consumer within its jurisdiction has access to water services that are affordable, economical and sustainable and must draw up a municipal water services plan for implementation. The municipality remains accountable for delivering services as the first port of call for public users who get no services or who have trouble with their services. Lastly, the municipality is accountable to "all clients or potential clients within its jurisdiction to ensure efficient, affordable, economical and sustainable access to water services" (SAHRC, 2014: 29).

The SAHRC (2014: 28) states that, according to the National Environmental Management Act (NEMA), provincial governments must ensure that municipalities carry out their environmental management plans in accordance with the NEMA (South Africa, 1998a, as cited in SAHRC, 2014: 28). The SAHRC also has stated (2014: 28-29), however, that "it is questionable to what extent the provincial government effectively fulfils this role".

In 2001, South Africa introduced a free basic services strategy that included water, electricity and solid waste collection. Under this policy, each household will receive free of charge the first 6 000 litres of water per month, based on an average of 25 litres of water per person per household of eight people per day (WWF-SA, 2016: 88). When local government systems fail, businessmen who charge high prices for tanked water frequently step in with the

net effect that disadvantaged people often pay most for services they should get completely free (WWF-SA, 2016: 66).

However, municipalities will specify whether free basic water is only available to the poor and how to identify and describe the poor. Of the 169 WSPs (municipalities), 29 provide their residents with free drinking water, 136 provide water, and four municipalities do not provide water to any resident (WWF-SA, 2016: 88). Users are required to pay for water used over and above the free water threshold. Consumption of over 6 000 litres (6 kl) per month is calculated based on increasing block tariffs. Theoretically, all families benefit from a free water lifeline, subsidised by increased block tariffs penalising wealthy households and deterring over-consumption (Du Plessis, 2010: 109).

Local government is the "backbone of the democratic system", as the government is nearest to the people (Zybrands, 2011; Meissner, 2015, as cited in Meissner et al., 2018: 115). Proper contact between residents and local authorities is not merely a theoretical concept, but is also enshrined in legislation and has practical implications on ground level (Meissner et al., 2018: 115).

Meissner et al. (2018: 114) stated that their reasoning is that observations by individuals may provide decision-makers with valuable data on water safety standards, particularly at the municipal level, where water safety definitions differ significantly based on context. This implies that residents and municipal authorities have various opportunities and difficulties in ensuring water security. That said, stakeholders should ideally be individuals who have water-security expertise and experience as part of their credentials when representing people's views on water security (Meissner et al., 2018: 114).

Interestingly, Meissner et al. (2018: 115) stated correctly that the effects of water insecurity are reflected by protests against municipal service delivery. Water and sanitation services of the affected municipalities demonstrate individual water security challenges. Own perceptions of water security are benchmarked against perceptions of the local municipalities' ability to provide essential water purification, reticulation and water services (Meissner et al., 2018: 115).

Increased discontent with the delivery of services continues to cause significant disruptions, threatens the stability of certain groups and potentially the nation, and endangers the delivery of vital services. Revenue inequality, unemployment and poverty are the fundamental causes of protests. Poverty is compounded by food and energy prices (Department of Defence, 2015: 2-17; Meissner et al., 2018: 115).

In addition to these problems, the government is at fault by continuing to grant money to municipalities that are unable to spend it properly and municipalities are at fault for not functioning as they ought to. "Municipalities are not capable of planning, managing and operating their water services" (Kings, 2018b). It has become increasingly evident that municipalities with big amounts of outstanding debt generally have weaknesses in their capacity to handle the value chain of revenue. Any weakness in the value chain system will jeopardise the municipality's ability to obtain what was billed efficiently. This is caused by poor financial planning, overspending, weak fiscal discipline and inadequate financial management (Njobeni, 2019: 8).

An example of poor fiscal management is the case of the Madibeng municipality. Njobeni (2019: 5) reported that Madibeng, which encompasses the tourist region of Hartbeespoort, is a perfect symbol of incompetent local governance. The North Gauteng High Court ordered Madibeng to pay R45 million in water levies to the DWS in May 2019. Madibeng is one of 44 municipalities that forfeited municipal infrastructure grants owing to failure to spend a R60 million grant on infrastructure development. The grant was eventually reallocated to other municipalities. Based on the above, the comment has been made of late that municipalities are not only mismanaged, but have progressively become debt-ridden. The consolidated municipal debt of South Africa now stands at R162 billion, according to the National Treasury (Njobeni, 2019: 5).

2.7.1 Auditor-General South Africa Report on municipalities during the financial year 2017/18

The Auditor General South Africa’s (AG SA) Report for the FY 2017/18 revealed the following interesting findings on financial and regulatory compliance at municipal level:

- Overall, audit findings deteriorated. The audit results of 63 municipalities regressed, and those of 22 improved. Only 18 municipalities were able to issue consistent financial statements and performance reports and comply with applicable financial and performance management regulations, resulting in a clean audit, down from 33 clean audits the previous year (CoGTA, 2019; Makwetu, 2019b: 2).
- In 92% of the municipalities, the report revealed material non-compliance with legislation. Municipalities with material compliance results for the management of the supply chain improved from 72% to 81%. These are the most significant non-compliance percentages since 2011-2012 (Makwetu, 2019b: 2).
- Irregular spending remained high but reduced from R29,7 billion to R25,2 billion (Makwetu, 2019b: 2). In the 2018/19 FY this figure increased to R32,06 billion (Makwetu, 2020a: 23).

- It was found that 74% of municipalities did not adequately follow up reports of alleged wrongdoing or fraud in the economic and supply chain management environment. Furthermore, 45% of municipalities did not have all the appropriate processes in place for reporting and investigating wrongdoing or suspected fraudulent activities (Makwetu, 2019a: 3).
- The Municipal Council refused to address all instances of unlawful, excessive, and fruitless and unwanted spending reported over the previous year in 62% of municipalities. Such municipalities did not take sufficient measures to write off, approve or permit unauthorised, irregular and fruitless or wasteful expenditure as required by legislation (Makwetu, 2019a: 3).
- During increased contestation of audit findings and pushbacks, audit practices and audit team intentions were questioned during various audit checks, and the audit environment in many instances became very hostile. In certain municipalities, pressure was applied on audit teams to change findings merely to avoid adverse audit reports or the disclosure of excessive spending – without appropriate grounds (Makwetu, 2019a: 3).
- Makwetu (2019a: 3) has recorded alarming statistics. Municipal public finances are rapidly showing signs of deterioration – 76% of municipalities have been found to need immediate intervention. Nearly one-third of municipalities are in financially precarious positions. Municipalities' failure to recover debt is common. Under these circumstances, municipalities would probably not balance books. Overall, 34% of municipalities recently reported a deficit (i.e. surpassed their income). The total deficit for these municipalities was more than R5.8 billion (Makwetu, 2019a:4). While the poor economic climate plays a role in worsening municipal financial health, many simply do not manage their finances as they should. Fruitless and wasteful expenditure amounted to R1.3 billion, which is totally unacceptable (Makwetu, 2019a: 4).
- In the AG SA report, Makwetu (2019a: 4) made an observation that was central to this study. The key concern is the lack of attention given to water and sanitation infrastructure, as 32% of municipalities responsible for water and sanitation have not inspected water and/or sanitation infrastructure at all, and almost half have no maintenance policies. Therefore, it is not surprising that 39% of municipalities that recorded water losses incurred losses of more than 30%, resulting in a total loss of R2.6 billion (Makwetu, 2019a: 4). This trend continued into the 2018/19 FY. In the 2020 AG Report, the AG SA reported that this figure had increased to R6,56 billion (Makwetu, 2020a: 23-24).

Based on the above a negative trend can be seen between the 2019 and 2020 AG reports as more and more municipalities find themselves unable to submit clean financial statements. It is evident that in most municipalities a skills shortage exists and that there is a total disregard

for compliance with governance and in the process service delivery to the people is being compromised.

2.7.2 Poor water service delivery and water protests

The National Master Plan for Water and Sanitation (2018a:5-2) indicates that since 1994, substantial infrastructure for freshwater supply and sanitation has been implemented throughout South Africa. It is projected that 95% of South Africa's population now has access to clean water. An additional 12 million people have gained access to water since 1994. However, around three million people and several schools still lack access to basic water services (The Centre for Development and Enterprise, 2010: 7).

This is a critical issue that needs to be resolved. In 2016, 63% of all households rated water quality services as excellent. However, satisfaction had dwindled rapidly since 2005, when 76.4% of users considered the service to be excellent and the current proportion of the population that is satisfied with reliable water services has fallen below 1994 levels (NW&SMP, 2018a: 5-2).

The UN Development Programme Report (2006: 64) verified that this problem was reported in South Africa as early as 2006. Progress in terms of sanitation was less spectacular than that related to water. There are still 16 million people – one in three South Africans – who have no access to basic sanitation. The lack of consensus on an appropriate basic sanitation level, coupled with problems with demand generation, contributed to the failure (United Nations Development Report, 2006: 64).

South Africa has experienced large numbers of social demonstrations since 2004. Demonstrators claim that they are protesting against lack of service delivery and access to clean water (Tapela, Ntwana & Sibanda, 2015: iii). In 2012 the frequency, geographical spread and violence of post-apartheid service delivery-related demonstrations reached unprecedented levels. Among various reasons cited for protests was the issue of water service delivery, which had gained prominence. Although this growth is remarkable, complaints about water services are not new (Tapela, Ntwana & Sibanda, 2015: iii). Water services issues have been (and remain) part of a variety of conflicting complaints that masquerade under the rubric of service delivery issues and underpin many calls for social protest action. While this confusion reflects the interconnectivity of social services, it also masks the accuracy of the particular water service problems in question (Tapela, Ntwana & Sibanda, 2015: iii; Makwetu, 2019a: 3).

However, the most common limitation is complex permutations of multi-stage protest eruptions, which are often overlooked at grass-roots level (Tapela, Ntwana & Sibanda, 2015:

iii). These are generally non-violent social protests, in which only a small number of individuals take part, and often involve negotiations at plot and neighbourhood level and disputes about water and other basic services (Tapela, Ntwana & Sibanda, 2015: iii). Therefore, the prominence of water service delivery problems in South Africa has not provided clear insight into the political, economic, social, bureaucratic, historical and cultural contexts in which social protests take place. The historical and cultural contexts are the exact cause of complaints about the provisioning of water services to communities and how these complaints intensify into violent protest actions (Tapela, Ntwana & Sibanda, 2015: iii). The link between access to water, service delivery, water security, quality of life for communities, human security and social stability is clear.

2.7.3 Mismanagement and pollution of water sources in South Africa

Natural water resources in South Africa are polluted by runoff emanating from mining, manufacturing, agriculture, development, and human settlement activities. A drastic turnaround strategy is needed to fight current pollution levels and prevent further pollution. Droughts come and go, but pollution remains a constant issue and needs to be resolved if water is to be used sustainably now and in the future (WWF-SA, 2016: 51).

Long-term monitoring over the last 20 years indicates that water quality has significantly declined in most South African rivers and dams. In certain regions, water quality also poses significant health threats to people and animals (WWF-SA, 2016: 51; South Africa, 2017: 21).

Historically, the primary objective of the DWS was water quality management. However, there are other government departments, mostly the Ministries of Environmental Affairs, Mineral Resources, Agriculture, Forestry and Fisheries, Health, Human Settlements (DHS), Education, CoGTA[3], National Treasury[4], and Trade and Industry, whose policies have a profound impact on water quality. Water quality control is also a government responsibility under the DWS, with private and civil society functioning collectively (NW&SMP, 2018a: 7-3).

The above matters and the many role players who all make a contribution somewhere along the value chain of clean water delivery to the people indicate that there are far too many boxes that must be ticked before clean water passes through a tap. From a pure management perspective, it becomes a nightmare if this task is not overseen and managed by one

[3] CoGTA is responsible for general oversight and support of municipalities and the broader network of intergovernmental relations. It also oversees the national government's national disaster response programme involving provincial and local governments (Muller et al., 2018: 16).
[4] The National Treasury offers grants and regulates municipal financial conduct. It also sets public service procurement standards and regulates certain aspects of state-owned bodies' operations, such as water boards and the TCTA (Muller et al., 2018: 16).

body/department or organisation. If this is left unchecked, the system will fail, as is happening in certain municipalities all over South Africa. With so many role players involved to ensure that water quality adheres to a minimum standard, without proper control measures failure is guaranteed.

Water quality refers to the environmental, physical and biological characteristics of water and is a measure of water status relative to water quality adherence levels, or according to water quality specifications of one or more biotic species or water consumers receiving water (NW&SMP, 2018a: 7-1). While scientific measures are used to determine water quality, saying "this water is good," or "that water is poor" is not a simple matter. The quality of the water needed for industrial purposes is generally not the same as that needed for domestic consumption purposes. Water quality should, therefore, be consistent with or appropriate for the intended use of a defined standard, whether for agricultural, domestic, industrial, recreational or spiritual uses, or its suitability to sustain a healthy aquatic ecosystem (NW&SMP, 2018a: 7-1).

Under Article 24 in the Bill of Rights (South Africa, Constitution of SA Act, 1996: 11), the right to access to a safe, unpolluted and clean environment is discussed:

“Everyone has the right-

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-

(i) prevent pollution and ecological degradation.

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use

of natural resources while promoting justifiable economic and social development” (South Africa, Constitution of SA Act, 1996: 11).

The National Water and Sanitation Master Plan (2018a: 7-1) states that South Africa faces a variety of water quality issues, involving surface and groundwater discharges from both the point of source, such as industrial processes and municipal wastewater treatment works, and non-point sources due to runoff from land. Approximately 83% of the national monitoring sites in the country represent some form of challenge in water quality (NW&SMP, 2018a: 7-1). Deteriorating water quality can significantly reduce the economic growth potential of the country. The decline in water quality in rivers, streams, dams, wetlands, estuaries and

aquifers affects the environment, human health and the internal dynamics of a healthy aquatic ecosystem (NW&SMP, 2018a: 7-1). Deteriorating water quality reduces the amount of water available for use, as there is a need to store more water to maintain dilution power in rivers. It increases the cost of production, as many companies are forced to treat the water they use in their production processes (NW&SMP, 2018a: 7-1).

Poor communities have the highest prevalence of disease profiles resulting from inadequate access to water and sanitation facilities. In underserved areas, people pay elevated rates to purchase clean water and often encounter unreliable supplies. Under-serviced areas are also areas where faecal contamination poses some of the most serious health risks and are, therefore, the areas where diarrhoea is most prevalent (Mackintosh & Colvin, 2003: 101; Haldewang, 2009: 3; Donnenfeld, Crookes & Hedden, 2018: 6).

Infectious diseases associated with drinking water include gastrointestinal disease, amoebiasis, salmonellosis, dysentery, cholera, hepatitis and typhoid fever. Diarrhoea (Donnenfeld, Crookes & Hedden, 2018: 6) is a growing sign of these illnesses that may pose a major threat to health in areas where faecal and untreated wastewater infiltrates water supplies. Although deaths due to diarrhoea have declined steadily in the last half-century, this disease remains one of the main triggers of childhood disease and death (South Africa, 2015: 454, Health-E News, 2019).

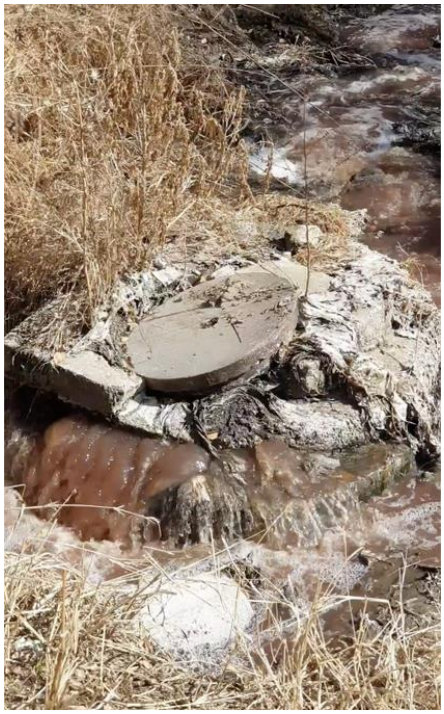
The degradation of water quality also affects human well-being. At the same time, productivity decreases as more working days are lost due to water-related conditions and, lastly, it threatens many sectors of the economy by affecting agriculture and making crops vulnerable to import restrictions by major trading partners. Some of the consequences of declining water quality, such as large fish kills, are immediately visible, while others are more gradual and longer lasting. In combination, they have an adverse impact on South African socioeconomic growth (NW&SMP, 2018a: 7-1).

Issues of water quality and water quantity are inextricably linked, and water quality management cannot be performed separately from abstraction, storage and use. One aspect of water quality management is the recognition of water resources' limited ability to absorb waste that is unsuitable and useless to water resources, causing loss of ecological sustainability (NW&SMP, 2018a: 7-1). This raises the cost of processing to ensure the safe use of the water (WWF-SA, 2016: 51). Farming faces the biggest challenge in terms of crops containing untreated water that may contain pathogens such as E-coli, which threaten the health of the population and export of products. The mixed population density, rapid urbanisation, inadequate freshwater infrastructure and wastewater treatment facilities of South Africa all exacerbate the worsening situation (Muller et al., 2009: 22; defenceWeb, 2010).

According to the WWF-SA (2016: 51), the most common sources of contaminants influencing water quality in South Africa are: “1) Poorly handled wastewater effluent from failure to treat wastewater; 2) Poor sanitation in informal and rural settlements; 3) Mining activities and ore processing, especially acid mine drainage; 4) Industrial effluents such as shampoos, pesticides, dyes and plastics industrial waste that contain pharmaceutical endocrine-disrupting chemicals; and 5) Runoff from agriculture including fertilisers, sediments and pesticides”.

South Africa, like many other countries, is also subject to pollutants such as nanoparticles, microplastics, antibiotics, endocrine chemicals and persistent organic pollutants. Comprehensive surveillance and/or study is essential to enhance knowledge about and determine the impact of these pollutants (South Africa, 2017: 21). As an example, it is well documented that the impact of pollutants entering the river system of the Loskop Dam, have led to the demise of endangered species such as the Nile Crocodile (Crocodylus niloticus), attributed to pansteatitis, as well as the mortality of several fish species in the dam. A decline in piscivorous bird species has also been observed, including Pel’s Fishing Owl (Scotopelia peli) (Skowno, Poole, Raimondo, Sink, Van Deventer, Van Niekerk, Harris, Smith-Adao, Tolley, Zengeya, Foden, Midgley & Driver, 2019: 96).

Similarly, as shown in the photographs below, the Vaal River system consistently suffers from fish die-offs due to pollutants and untreated sewage being released into the river system on a regular basis (Vaal River Pollution, 2020a; Vaal River Pollution, 2020b).



Untreated sewage spilling into the Vaal

Fish die-off in the Vaal River

2.7.4 Water standards

In 2008, the then Department of Water Affairs (DWA) launched two certification programmes, the Blue and Green Drop Assessment, to assist municipal authorities in supplying safe water and sanitation. Together, WSAUs offered a comparative benchmark and transparent information system to provide outstanding quality drinking water and effective wastewater treatment. The Blue Drop Report covered all natural sources: rain, waterways, wetlands, and dams, while the Green Drop Report engaged wastewater systems (WWF-SA, 2016: 56). Since 2013, a risk assessment tool has been included in the process to assess the overall risk of a treatment system failure and the associated risks to citizens, the economy and the environment (WWF-SA, 2016: 56). According to the 2013 Green Drop Report, less than 10% of 824 water treatment plants in the country released clean water. The remainder broke the law, with a third classified as 'critical' and urgently requiring repair. This equated to 50 000 litres of untreated sewage released every second into the country's river systems (Kings, 2017).

Eutrophication involves excessive enrichment of nutrients because of phosphates in the rivers, which cause algae and other aquatic plants to grow exponentially. This drives out other animals, which can contribute to fish die-offs as the algal bloom decomposes when oxygen is exhausted (The Centre for Development and Enterprise, 2010: 9; WWF-SA, 2016: 53). This is a big problem in the dams of Hartebeespoort, Rietvlei and Roodekoppies, where efforts are being made to regulate it (DWA, 2012 as cited in FAO UN, 2016:14). It is also caused by toxicants, suspended solids, radioactivity, and agricultural chemicals (DWA, 2013). Since agriculture primarily uses water not previously treated, except for a small portion using treated wastewater, the effects in agriculture are therefore of concern (DAFF, 2012b as cited in FAO UN, 2016: 14).

The DWS has monitored the condition in connection with the installation and repair of wastewater treatment schemes and related sewage infrastructure through the Green Drop assessment. Green Drop assessments have not been carried out since 2014. Kings (2017) reported that it was previously revealed that the Green Drop Reports provided negative evidence that should enable communities to prosecute the government for allowing the quality of water to deteriorate to the point that it becomes unfit for human consumption in untreated form. This represents lack of commitment to the proper management and maintenance of wastewater at most municipalities (NW&SMP, 2018a: 5-10).

Such claims support the often-quoted statement that the release of more than 80% of all sewage water globally takes place without any treatment. The motivation for advanced wastewater treatment is either to maintain environmental sustainability or to provide an alternate supply of water in high-income countries that experience water shortages. However, untreated wastewater releases tend to be standard practice in developing countries because of inadequate wastewater treatment facilities, engineering resources, technical capabilities and financing (WWAP, 2017: 2). On average, high-income countries treat 70% of the urban and industrial wastewater they produce. In upper mid-income countries, this percentage decreases to 38% and in lower mid-income countries to 28%. In low-income countries, just 8% undergoes some form of treatment (WWAP, 2017: 2).

As water is more intensively used, the re-use of wastewater becomes more important. This is already a significant resource, and wastewater flows are taken into account in overall water resource planning. For example, in the Crocodile-Marico system, wastewater from the Gauteng area makes up over 50% of the total flow and is by far the most reliable contributor to the stream, which is the main source of water for parts of North West Province (DBSA, 2016: 19).

The present direction cannot be the destiny of South Africa. As previously stated by the Centre for Security Studies, sensible approaches are available to tackle the problem. South Africa treats only about 60% of its wastewater, and a significant quantity of its existing equipment is degraded, which means that the real figure could be much lower than 60%. Other countries experiencing water scarcity, like Israel, treat about 80% of their wastewater. Wastewater disposal technology is also considerably cheaper than other options, such as desalination (Donnenfeld, 2019: 5). In the Middle East and North Africa, Australia, the Mediterranean and Windhoek in Namibia, there are a variety of other examples. Since 1969, Windhoek has been reclaiming wastewater for drinking. A new plant was commissioned in 2002, incorporating the latest advances in technology, to secure household wastewater treatment in Windhoek (Connor, Uhlenbrook, Koncagül & Ortigara, 2017: 8; WWAP, 2017: 126). Israel uses desalinated water for both agriculture and for the treatment of wastewater. A master plan implemented in 2002 called for the construction of 400 million m^3 of large marine desalination reverse osmosis plants (Dickie, 2007: 28). In order to increase irrigation water, 2,1 billion m^3 of wastewater is treated annually via various desalination plants across Israel (Klein Leichman, 2019).

The 2017 World Water Development Report states that better management of wastewater is more concerned with reducing pollution from sources as pollutants are eliminated in wastewater flows, the re-use of water that has been treated, and recycling of valuable by-products. The four actions add social, environmental and economic benefits to

society in general and lead to overall well-being and quality of life, water and food security and environmental sustainability (WWAP, 2017: v).

Faced with increasing demand, wastewater is becoming a sustainable supply of renewable water, transforming the wastewater management paradigm from 'treatment and disposal' to 're-use, recycle and recovery.' Wastewater is no longer seen as an issue that needs a solution in this regard, but is part of the solution to society's problems (WWAP, 2017: 1).

The general lack of collection and treatment infrastructure, which contributes to pollution of frequently constrained groundwater and surface resources, is one of Africa's main wastewater obstacles. African cities are expanding, and their current water management infrastructure cannot satisfy the increasing demand. However, this scenario provides incentives to develop municipal wastewater treatment systems through multi-purpose water recovery and re-use (Connor et al., 2017: 9).

2.7.5 Non-revenue water

Non-revenue water (NRW) includes all unpaid water that is made available, including actual water losses from delivery network spills, inadequate connections, unbilled and billed usage, but not water consumption that is paid for. Municipalities waste nearly 1 660 million m^3 of water each year through non-revenue runoff. This is R9,9 billion per year at a rate of R6/m^3 per unit (WWF-SA, 2016: 64; NW&SMP, 2018a: 1-1; Kings, 2018b).

The War on Leaks by the DWS began in 2015 to address water losses countrywide (Arnoldi, 2018). The Water Research Commission mandated the University of Stellenbosch to conduct a study on water losses in the country. The research showed that South Africa loses up to 37% of drinking water as a result of lack of infrastructure maintenance and illegal connections, compared to the best worldwide practice of 15% (WWF-SA, 2016: 64; Arnoldi, 2018; NW&SMP, 2018b: 7; Donnenfeld, 2019: 5).

The high amount of NRW has compounded the supply challenge. It is a major task to prevent, monitor and repair water losses in deep rural regions. Leakages are due to anything from burst or blocked pipes to running taps that are left unattended. The availability of potable water can be improved through the detection and repair of leaks in the current water reticulation infrastructure.

To reduce NRW loss, the DWS initiated the "War on Leaks" campaign. As part of this campaign, the DWS has taken on the challenge to hire out-of-school young people to undergo training to detect and prevent leakages as water agents, artisans and plumbers (Arnoldi, 2018).

As water supply will not be able to meet demand in years to come, recycling of wastewater, prevention of pollution and prevention of water losses will have to become the new standard of the way people live in South Africa. It can no longer be the government's problem to deal with. It is time for a paradigm shift in water use.

2.8 CLIMATE CHANGE AND THE IMPACT THEREOF ON SOUTH AFRICA

Marquard at the University of Cape Town's Energy Research Centre is on record as stating: "I would say that for any drought in Southern Africa now, there is a climate factor. It seems the latest science is that we are now not anticipating climate change; we are now in it" (Cupido & Taylor, 2019: 4).

In the absence of intervention to curb emissions, Stern (2007: vi) claimed that greenhouse gases in the environment could reach double their pre-industrial levels by 2035, which will in practice contribute to an average global temperature rise of over 2°C. In the long term, there is a 50% chance of a temperature increase exceeding 5°C. This temperature rise will be very harmful. It equates to the rise in average temperatures between the last ice age and today. Such a dramatic shift in the world's physical landscape will lead to significant shifts in human geography – where people live and how they live.

Welborn (2018: 3) asserted the inevitability of climate change. Regardless of the carbon control steps implemented today, warming will continue, and climate change effects are likely to escalate over the coming decades owing to earlier pollution and the climate system's inertia. However, the magnitude of these consequences post-2050 depends on the short-term elimination of emissions by global leaders (Welborn, 2018: 3). If they struggle and emissions rise unmitigated, global warming up to 4°C above pre-industrial concentrations would most definitely occur by 2100. If the temperature increases by 4°C in certain parts of the globe, the limits of human survival and the adjustment capability of natural resources and ecological systems are likely to be exceeded (Welborn, 2018: 3).

The past, present and future are influenced by the prevailing climate conditions. The climate is the only global variable that directly and deeply affects every aspect of human life. The climate shapes the natural environment, economies, construction of politics and power, cultures, social interaction and development. Advances in production and human technology have had an intense and permanent effect on the natural setting and on the entire climate (Van Niekerk, Tempelhoff, Faling, Thompson, Jordaan, Coetsee & Maartens, 2009: 1).

In short, rising scarcity will result in the capturing of resources by those with the means to do so, and the disenfranchisement of those without. The lack of "adaptive capability" of African states (Homer-Dixon & Blitt, 1998: 9, as cited in Englebert & Dunn, 2013: 287) may

make them especially vulnerable to these forces. The argument is that economically disadvantaged nations, lacking both financial and human resources and being ethnically diverse, are less likely to be able to cope with extreme environmental challenges aggravating the scarcity of resources (Englebert & Dunn, 2013: 287).

Average South African temperatures have increased about one and a half times as fast as the global average of 0.65°C over the last five centuries. Maximum and minimum average temperatures have risen in nearly all seasons and regions. Changes in rainfall indicate weaker patterns, but the number of rainy days is decreasing in almost all regions. Extreme rainfall events have occurred frequently, especially in spring and summer (McSweeney & Timperley, 2018:22). The dangers posed by climate change include changing rainfall patterns, higher evaporation rates, higher temperatures, rising pests and diseases, shifting growth areas and lower production and crop yield (McSweeney & Timperley, 2018: 22).

South Africa is abundant in biodiversity and accounts for about 10% of the world's insect, fish, and plant populations and about 6% of mammals and reptiles. The habitats of these animals will be strained in a hotter, dryer climate and will change drastically (McSweeney & Timperley, 2018: 23).

In October 2018, a crucial study from the Intergovernmental Panel on Climate Change (IPCC) was released advising that warming of 1.5°C above the pre-industrial level may be reached by 2030 in Welborn (2018: 3). This amount of warming is unsustainable; major food deficits and extreme storms are likely to occur if warming of 2°C is reached. The scientific world is stating that warming should be restricted to 1.5°C and not 2°C. This would require the involvement of global leaders who have been called upon to change the world economy rapidly, as envisaged under the Paris Agreement. Doing so may require an almost unprecedented degree of coordination as a global human survival mechanism (Welborn, 2018: 3). No economy is resistant to the impacts of climate change, but small growth areas are excessively affected. Africa is especially sensitive to climate change impacts, and as the world's hottest continent, with more than half the world's poor, is particularly vulnerable to climate change (Welborn, 2018: 3).

The opinion is supported that in an asymmetric water access scenario, the danger is often real that a nation can take the resource from another or dislodge others without access (Englebert & Dunn, 2013: 287). This is backed up in *The 2020 World Climate and Security Report* (2020: 12), which notes that increasing research associates climate change with an increased risk of violence, especially in areas with increasing instability. A new analysis released in Proceedings of the US National Academy of Sciences has found that climatic disturbances in ethnically divided countries worsen and raise the risk of intermittent violent

conflicts (The 2020 World Climate and Security Report: 12). Data from 1980–2010 on armed conflicts and climate-related natural disasters showed that almost 23% of outbreaks of conflict in ethnically highly fractioned countries have a strong correlation to climate disasters, such as heat waves and droughts (The 2020 World Climate and Security Report: 12). Each normal climatic adjustment variance, from warmer temperatures to more extreme precipitation, would increase interpersonal conflict by 4% and the level of intergroup conflict would increase by 14%. This study deemed these figures to be significant, since many regions worldwide are predicted to warm up to 2050 by between two and four standard deviations (The 2020 World Climate and Security Report, 2020: 12).

Similarly, in a no-mitigation scenario, by the end of the century, global warming could reach 4°C around the globe, perhaps more than 6°C in some western inland areas of South Africa (McSweeney & Timperley, 2018:23). This is supported by Van Niekerk et al. (2009:2) who in 2009 predicted that by 2050, the surface temperature in South Africa will have increased 2°C in several regions. Low winter temperatures are forecast to increase by 3°C on average. These observations are based on rising surface rock temperatures in South Africa taken from borehole temperature profiles (Van Niekerk et al., 2009: 2).

Kuhlman (2018: 7) is of the view that famines are often the consequence of droughts, but conflicts have also exacerbated famines. Kuhlman (2018) stated that although certain parties may disagree with the notion of climate change, nobody can deny that today in Africa serious side effects persist or that these challenges add to the region's fragility and insecurity. To add to Kuhlman's (2018: 7) observation, it has been reported in the Defence Review (2015: 2-29) that some of the most serious threats to humanity are caused by climate change, including an increase in the frequency and severity of floods, hurricanes, cyclones and wildfires. Prolonged droughts and increasing desertification are only some of the forecasts for Africa and the region, which could hinder food production and lead to famine (Department of Defence, 2015: 2-13).

Water is the main mechanism through which the impact of climate change in South Africa is felt, according to the National Water Policy (Department of Water Affairs, 2013, as cited in Department of Environmental Affairs, 2017: 7). Increased climate variability and severe climatic factors influence water quality and accessibility through shifts in weather trends, including heavy rains, flooding, droughts, soil moisture and rainfall variations. Climate change also contributes to increased evaporation and rising temperatures in aquatic ecosystems (Environmental Affairs Department, 2017: 7). Since 2015, South Africa has experienced severe drought with crop losses and water scarcity that have affected food and water security (Department of Environmental Affairs, 2017: 7).

De Wet and Liebenberg (2018:2) believe that poverty and hunger remain unique to 'lesser' and 'poorly' developing countries. Conflicts remain a fact associated with limited resources such as water and food (including arable land as a resource) that are contested not just among countries, but also within countries and communities. One example of globalisation that causes violent clashes is oil exploration, which still damages productive, fertile agricultural land in the West. Munro and Van der Horst (2015: 119ff, as cited in De Wet & Liebenberg, 2018: 2) documented an example of the relationship between conflict, displacement, attempted resettlement, the negative impact on forest ecology and agriculture in Sierra Leone. Some security analysts are already saying that water as a weapon will be used in the next international war. In areas where water is no longer available, food insecurity will increase (De Wet & Liebenberg, 2018: 2).

The Sahel, which stretches east to west across the continent south of the Sahara and north of the more forested areas of the Gulf of Guinea and Central Africa, is facing a similar fate. Research has pointed out that the average Sahel temperatures could rise by 14,28°C (6.3 degrees Fahrenheit) (Miguel 2008: 12, as cited in Englebert & Dunn, 2014: 220) and that rainfall could drop by as much as 25% in the second half of the 21st century (Held et al., 2005, as cited in Englebert & Dunn, 2014: 220). Climate models indicate that crop production in the Sahel could fall by up to 10% for sorghum, wheat and rice by 2030 (with millet output likely rising, however), while in Southern Africa corn output might fall by nearly 30% and wheat by 15%. In addition to a direct drop in the local availability of food and the significant danger of famine, reduced rainfall can also bring about mass resettlement and conflicts about land. Similarly, a 2007 UN Environment Programme paper found that the post-2003 conflict in Darfur, Sudan, was triggered by climate change and environmental degradation, which intensified competition among local communities for land, and predicted more such conflicts in the future (UNEP 2007, as cited in Englebert & Dunn, 2014: 220).

Cognisance should be taken of the parallels that can be drawn between climate change and its effect between Darfur and South Africa, where an extended drought is placing agriculture under strain. The drought in Darfur had a direct effect on the instability in the region in 2003.

2.9 ADDRESSING THE CONCEPT OF NATIONAL SECURITY AND THE NEXUS WITH WATER SECURITY

Security certainly implies different things for different people. Most international relations scientists work abstractly to define security, including threats to cherished values (Williams, 2013:1). Security studies should never be purely theoretical because they are largely

motivated by a need to provide security to real people in real situations (Booth, 2007, as cited in Williams, 2013: 1).

This requires interpreting the past (especially how various groups perceive and exercise security), understanding the present and trying to influence the future (Williams, 2013: 1). Nearly all of these initiatives involve the redefinition of the national policy agendas of states and not just the meaning of security itself (Baldwin, 1997: 5).

In the 'classic essay' by Arnold Wolfers, titled *National Security as Ambiguous Symbol*, the argument presented was a forecast in many respects. The following passage shows that Wolfers was concerned with the ambiguity of 'national security' as depicted by Baldwin (1997: 6):

> It would be an exaggeration to claim that the symbol of national security is nothing but a stimulus to semantic confusion, though closer analysis will show that if used without specifications it leaves room for more confusion than sound political counsel or scientific usage can afford.

The security concept should first be discussed to comprehend the meaning of ‘security’ before seeing why 'security' means different things to different people. The question is asked: "What does security mean?"

2.9.1 Meaning of security

Williams (2013: 6) made a significant point that, by definition, if one supports the notion that security is fundamentally a contentious topic, such discussions can definitively not be resolved through abstract reasoning. Instead, such positions would be exploited using power and coercion (Williams, 2013: 6).

In this regard, as Williams (2013: 6) has stated: “[security] … is associated with the alleviation of threats to cherished values; especially those which, left unchecked, threaten the survival of a particular referent object in the near future”. While protection and survival are often related, they are not entirely compatible. Williams (2013: 6) supported the idea by suggesting that security is central to the achievement of political and social goals in knowledge and understanding of existential survival. Security is thus better described as 'the survival plus' (Booth, 2007, as cited in Williams, 2013: 6) and is thus 'the plus', being freedom from life threats and therefore some life choices. Williams essentially referred to why security implies various things for various people. The solution lies in the notion that security may be used as a political tool in the process of gaining government attention to prioritise problems or services (Buzan, 1991: 370, as cited in Williams, 2013: 2). It is also necessary to determine who is

responsible for what security entails, how security objectives are successfully addressed and what happens if specific security outcomes overlap (Williams, 2013: 2).

There are also reservations about the philosophy of knowledge, especially epistemology (how do we understand things?), ontology (what phenomena do we accept to make up the social world?), and methodology (how do we analyse the social world?).

In order to understand the concept of security pertaining to this study, with water as the referent object, one has to explore the concept of water security, food security and human security, as they are all interrelated in the absence of water. For this reason, water security is subsequently discussed in more detail.

2.9.2 The concept of water security

Climate change and resulting water insecurity are seen as a potential threat to governments, but remain a scarcely understood phenomenon for stakeholders in national defence (The 2020 World Climate and Security Report, 2020: 23). Water's future is inextricably tied up with strife and rivalry. However, concentrating exclusively on the risk of water conflict it can weaken the very remedies addressing those risks. This strategy puts military and security agencies in the driver's seat, to the detriment of other main stakeholders (Risi, 2019).

Many people can have water security, although others in the same geographical region could remain water insecure. This is important to note, as many poor inhabitants in Gauteng and across South Africa still face some elements of water insecurity every day, in particular those in informal settlements (Muller et al., 2018: 7). Household water security implies a constant supply of clean water in the house for every domestic purpose. In Gauteng, for example, accessibility to secure sanitation for all is also lacking in some instances and is part of the wider definition of water security (Muller et al., 2018: 7).

The achievement of water security includes a broad variety of people and institutions. It includes the quality of water that can be impaired by farming activities in dam catchments. It includes municipal technicians who evaluate the credibility of district networks that convey water to household taps and keep wastewater drains clear; or water users in their homes and workplaces who determine if scarce water resources are wasted or polluted. A system failure can disrupt services and compromise water security. It is generally found that poor communities are especially vulnerable to failures in the operation and maintenance of water resources and infrastructure (Muller et al., 2018: 7).

Gleick and Iceland (2018: 11) defined water security as the capacity of a population to:

- “Safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development;
- Ensure protection against water-borne pollution and water-related disasters; and
- Preserve ecosystems, upon which clean water availability and other ecosystem services depend” (adapted from UN-Water 2013, cited in Gleick & Iceland, 2018: 11, United Nations, 2018: 11).

Similarly, Muller et al. (2018: 7) defined water security as being achieved when there is: "[...] the secure supply of an adequate quantity and standard of water for health, livelihoods, ecosystems and development, combined with an acceptable level of water-related risks to individuals, environments and economies”. Such a definition covers all existing water sources and the services stemming from them. This encompasses the entire water cycle, from the rain that feeds rivers, lakes and dams to groundwater for household taps and treatment plants that purify used water before it returns to rivers or oceans. It also addresses climate-related challenges such as flooding, droughts, water quality and environmental protection (Muller et al., 2018: 7).

Gleick and Iceland (2018: 11) are correct in stating that water insecurity contributes to human insecurity, either explicitly (e.g. farmers do not have access to adequate water to sustain their lives and property) or indirectly (e.g. drought leads to higher urban food prices and to violent conflicts between farmers and pastoralists over resource scarcity). Water has played a significant role in the development of human security; however, in the recent past, exposure to water-related dangers has risen owing to the increasing risks to water quality and quantity. Populations in the Middle East, Africa in general and parts of Southern Asia are growing very rapidly. These global demographic trends lead to increased pressure on restricted water resources on a global scale (Gleick & Iceland, 2018: 2).

Africa is predicted to experience growing water scarcity and instability, increasing the possibility of enduring conflicts over this essential human survival resource. Population growth on the continent, uneven distribution of available resources and increased consumption of natural resources in general will result in increased demand and competition for essential natural resources, particularly water, food and land (Department of Defence, 2015: 2-14).

According to Gleick and Iceland (2018: 3), access to water is vital for all economic and social activities, from food and energy production to the conservation of ecosystems. Because of population and economic development, freshwater resources are becoming increasingly depleted, unequally distributed, increasingly polluted or overused, and poorly managed. This phenomenon is not exclusive to South Africa. The same is the case today in areas traditionally

considered to have access to ample natural water resources. These stresses have growing political and security consequences (Gleick & Iceland, 2018: 3).

Water scarcity differs widely from water shortages or water stress. Water shortages can occur because of lack of an accessible water supply, but also because of infrastructure failures, severe weather events or water quality degradation. Water stress is a result of water scarcity or water depletion. These signs may involve conflict or competition for small water reserves and decreasing reliability of service standards, accompanied by food insecurity (Hedden & Cilliers, 2014: 2). Growing numbers of citizens have moved to South African cities that already have a strained infrastructure for people dependent on services. Climate change has also made regular rainfall less frequent, contributing to increased water shortages (The 2020 World Climate and Security Report, 2020: 17).

Gleick and Iceland (2018: 1) are correct in stating that the destruction of the natural habitat and the release into rivers and lakes of untreated municipal, industrial, and agricultural sewage make much of the ground and surface water unusable. These growing water pressures are undermining global water security and contributing to conflict, migration and food insecurity in many regions of the developing world (Gleick & Iceland, 2018: 1).

Drought in failed states can be deadly, or can lead to states' failure. For instance, during the famine in Somalia, about 260 000 people died (Reuters, 2018). Drought forced millions out of Somalia and left hundreds of thousands of children malnourished, extending over a period of four successive poor rainy seasons. In the Horn of Africa, one in every four individuals faced the danger of starvation (Reuters, 2018). In an article by Kuhlman (2018: 7), titled *Strengthening Partnerships to Face the Complexities of Africa*, famines are reported to be nearly synonymous with Africa. Hunger in Africa affects more people than in any other region in the world and remains a relentless problem for the international community. The tendency of Africa to alternate dry and rainy seasons causes unpredictable water supply, rendering farmers and cattle herders vulnerable to large variations in production, exacerbated by the scarcity of irrigated agriculture (only 4% of all agricultural land in Africa is irrigated). Many regions of Africa encounter severe food scarcity in normal times, as the reserves produced during the rainy season recede by the end of the dry season. These shortages can quickly turn serious, sometimes to the point of famine. In the dry season, food supplies can drop drastically and rapidly, leaving rural residents with shortages and urban residents with increasing food prices, which are often unaffordable (Englebert & Dunn, 2014: 218).

The connection between water-food-human and national security and the impact of droughts in the future was explored and is now presented in more detail. With water as the

referent object, the mere absence of it, as there is no substitute for it, can have an effect on the stability of a region and affect the national security of a country or countries adversely.

2.9.3 The concept of human security

"*Human security is like 'sustainable development' - everyone is for it, but few people have a clear idea of what it means*" (Paris, 2001, as cited in Nugraha & Madu, 2013: 74).

The first significant human security declaration was released in the 1994 *Human Development Report*, an annual UN Development Programme (UNDP) document (Paris, 2002: 89; Nugraha & Madu, 2013: 74). The concept of 'security', the report claims, has been narrowly interpreted for too long as regional security against external aggression, protection of national foreign policy interests, or global security against a threat from the nuclear holocaust. The legitimate issues of ordinary individuals seeking security in their daily life were forgotten: "This critique is evident and strong, but the latter proposition in the report for a new view of security, specifically human security – lacks clarity. Firstly, it implies security from chronic threats such as famine, illness and oppression. Secondly, it implies protecting against sudden and harmful disruption of everyday life — in households, in employment or in communities". This definition has a broad scope: virtually any kind of unexpected or irregular discomfort could represent a threat to human security (Paris, 2002: 89). In anticipation of this criticism, Paris (2002: 90) identifies seven particular aspects of human security, namely:

- "Economic security (e.g., freedom from poverty)
- Food security (e.g., access to food)
- Health security (e.g., access to health care and protection from diseases)
- Environmental security (e.g., protection from such dangers as environmental pollution and depletion)
- Personal security (e.g., physical safety from such things as torture, war, criminal attacks, domestic violence, drug use, suicide etc.)
- Community security (e.g., the survival of a traditional way of life and ethnic groups as well as the physical security of these groups)
- Political security (e.g., enjoyment rights, both civil and political as well as freedom from political oppression)".

As a side comment, from this list, it is postulated that water security is incorporated under food security, as the inverse of food security – food insecurity – is a direct consequence of water insecurity or water stress.

The list compiled by Paris (2002: 90) is so broad that it is hard to determine what could be excluded from the human security definition, if anything. Indeed, the drafters of the report

did not seem to be interested in any definitional limits. Instead, they commended the 'all-embracing' and 'integrative' characteristics of the idea of human security that they seem to see as one of the main strengths of the idea.

The proponents of human security claim that human security represents a change in thinking from traditional state-centred security to human security for both normative conceptual and policymaking global security (Tadjbakhsh & Chenoy, 2007, as cited in Nugraha & Madu, 2013: 74). This claim is based on the radical challenge of human security to the ontology and security epistemology of traditional security. First, unlike the conventional state-focused strategy for security, the notion of human security emphasises people as the referent object of security. Second, the idea of human security focuses on non-military sources of insecurity that influence the lives of individuals as new sources of threat, which can contribute to global security issues (Nugraha & Madu, 2013: 74).

Despite criticism, human security emerges as a means of expanding security studies, deepening and opening security studies. It implies the inclusion of a wider variety of non-military threats, including poverty, environmental degradation, pandemics, migration and terrorism. Deepening means considering the safety of individuals and the effect on global security (Krause & William, 2006, as cited in Nugraha & Madu, 2013: 75). The opening up of the concept of security implies opening up the original definitions of security thinking (politics of security) by analysing the ontological and epistemological aspects of security (Wiber, 2008, as cited in Nugraha & Madu, 2013: 75)

In contrast, Williams (2008, as cited in Bester, 2019: 8) confirmed the transition away from the government (state-centred) security to the security of humanity as a collective, highlighting the individual's liberty from threats to physical security and eventually to a good standard of life and human dignity. The presence of individuals is, therefore, central to security assessment and intervention. It is evident from the above that human security is a notion that moves away from state-centred military exclusive threats to the ultimate preservation of collectives (population-centric), guaranteeing liberty from fear or want (Bester, 2019: 8).

Similarly, human security as defined by Gleick and Iceland (2018: 11) refers to human health and well-being as a whole, including social and economic events that lead to a favourable quality of life. It involves "people's liberty from want and liberty from fear" and individuals' security from threats that include disease, poverty, violence and abuse of human rights. The Human Security Commission, on the other hand, describes human security in ways that increase human freedom and fulfilment as the protection of the vital core of human life (Commission on Human Security, 2003: 4, as cited in Nugraha & Madu, 2013: 74, Paris, 2002: 90).

As the notion of security is extended, enhanced, refocused and expanded, the dominant theoretical reconceptualisation of security as human security developed (Axworthy, 2001, as cited in Bester, 2019: 7) and a plethora of definitions emerged.

The authoritative definition from the 1994 Report of the Commission on Human Security, as cited in Hampson (2008: 232, as cited in Bester, 2019: 7), is as follows:

- Human security requires the safeguarding of fundamental human rights.
- It involves protection of individuals from critically important and common threats and situations.
- It implies the use of procedures that build on people's strengths and desires.
- It implies the development of political, social, environmental, military and economic structures and systems that in unison provide a basis for the survival of people (Bester, 2019: 7).

South Africa is one of few countries in the world that spends less on defence than on water and sanitation (UN Development Survey, 2006: 62). The budget priorities raise some important questions about public spending. National security and defence are priorities for all countries across the globe. Yet, within the perspective of human security, it is difficult to resist underfunding the supply of water and sanitation relative to military expenditure in the rest of the globe (United Nations Development Report, 2006: 62).

The universal right to water entitles everybody to adequate, clean, easily accessible and affordable water for both domestic and private usage (Bellettin et al., 2005, as cited in Stats SA, 2015: 22). The social impact of safe water cannot in any way be overlooked and cannot, therefore, be overemphasised as a vital element for economic growth, peace and stability.

2.9.4 The concept of food security

Food and water security are interconnected. Food insecurity arises from a variety of weaknesses, based on how individuals access production and exchange opportunities. This in effect is caused by massive spending in terms of households' time, work or resources to obtain access to water. In many rural settings, domestic water is also a production enabler to make a living. Water security will, both directly and indirectly, influence opportunities for household production and income-earning, and the efficiency and volume of water use (Calow, MacDonald, Nicol, & Robins, 2010: 255). That is directly related to poverty reduction and the unemployment agenda (NPC, 2012: 110; International Bank for Reconstruction and Development & The World Bank, 2018: 11; Stats SA, 2018: 2).

Moreover, there is a substantial risk of food insecurity for individuals in urban settings. Research has found that this is especially true because of the physical environment in which

individuals live, particularly children. Enhanced hygiene and sanitation and safe access to water can decrease infections. Ingesting faeces and soil contributes to the risk in especially polluted environments, such as dense informal settlements (International Bank for Reconstruction and Development, 2018: 27).

According to De Wet and Liebenberg, (2018: 4), the Department of Agriculture, Forestry and Fisheries and the Food Security Directorate describe three aspects of food security :

- Countries must have sufficient quantities of food supplies available for both domestic and national use.
- States must be able to obtain appropriate food for the country and its families on a viable basis (import where needed).
- Comprehensive knowledge of food and nutrition (Du Toit, 2011: 2, as cited in De Wet & Liebenberg, 2018: 4) should be the basis of food consumption.

Interestingly, as reported in the Defence Review (2015: 2-13), the current trend around the world is that among the 39 countries in the world experiencing food emergencies, 23 are in Africa. It has also been noted that an increase in population growth and consumption on the continent will continue to erode poorer nations' capacity to lift people out of poverty and underdevelopment. Sub-Saharan Africa will have an estimated population of 1.3 billion people by 2035, and 54% of total population will reside in metropolitan regions by 2025 (Department of Defence, 2015: 2-13).

South Africa is generally considered a food-secure state. Still, the same cannot be said of rural households that lack food security because of poverty (Du Toit, 2011: 4; Haldewang 2014; Pillay & Southall, 2014; Sithole, 2014, as cited in De Wet and Liebenberg, 2018: 4). Turton and Henwood (2002: 240) noted that food security is a strategic problem of great importance in Southern Africa. Indeed, it could readily be asserted that some Southern African nations, such as South Africa, Botswana, Namibia, and Zimbabwe, are only water-scarce if each selects a policy of domestic self-sufficiency in food. This would imply substantial agricultural water mobilisation. If food security is practised instead, water stress will become manageable and political stability and economic development can be ensured in the region (Turton & Henwood, 2002: 240).

The International Bank for Reconstruction and Development (2018: 26) has reported that the position of agriculture in the South African economy is decreasing noticeably. The incidence of smallholder agricultural production in comparison with other African nations is low; it is striking that families involved in some type of subsistence farming are more likely to be food-secure than those who are not. This indicates that measures that promote food

production would be suitable, even if these are not an essential element of government food security and nutrition strategies (International Bank for Reconstruction and Development, 2018: 26).

Gleick and Iceland (2018: 8) suggested that water and security issues are gaining further focus because of increasing indications that natural resource depletion is the root cause of conflict, migration and chronic food insecurity. Many scholars are already studying these and similar concerns (e.g. links with climate change and conflict). To identify problems early and recommend appropriate, effective solutions, it will be advantageous if the link between water and food security is understood better.

The article, *Climate and Southern Africa's water–energy–food nexus*, confirms the idea that climate plays a vital part in determining medium-term water accessibility, agricultural output, and "some of the energy and demand components" (Conway, Van Garderen, Deryng, Dorling, Krueger, Landman, Lankford, Lebek, Osborn, Ringler, Thurlow, Zhu, and Dalin, 2015: 843). Climate variability leads to water-energy-food element fluctuations. Climate variability and exposure to climate change are high in all industries that include areas of economic activity in South Africa, and the effect of individual climatic events are strongly corroborated. The article of Conway et al. (2015: 843) gives the example of the 1973 El Niño that resulted in a drop in the GDP of South Africa. Climatic changes led to GDP variations up to US $5 billion. In a similar fashion, it is stated that in 2000 the floods in Mozambique had a devastating impact on livelihoods, interruptions in power supplies and necessary infrastructure and services (Conway *et al.*, 2015: 843).

It is also remarkable that, although the modern effect of financial liberalisation on food security is evident, countries that in the last 60 years have decided to prioritise food security have been able to lift their populations out of food insecurity. There are several examples: Sri Lanka, Southeast Asian countries and Cuba (Williams, 2013: 305).

South Africa maintains that addressing the triggers and consequences of uncertainty encourages a human-friendly climate. This national security approach puts a legitimate, reliable, and internally developing state at the heart of the broader agenda to create a better South Africa for all (Department of Defence, 2015: 3-4).

Thus, South Africa has three primary targets:

- Promoting people's well-being, growth and upliftment to free them from fear and desire.
- Protecting the planet and managing climate change to guarantee sustainability for future generations of energy, water and food resources.

- Prosperity of the country, region and continent through viable financial growth and development (Department of Defence, 2015: 3-4).

Safety is characterised as inherently political, i.e. it plays a critical role in determining who is granted what, when and how in politics. Williams shares Booth's view (Booth, 2007, as cited in Williams, 2013: 1) that security studies may never be simply an educational undertaking; as it is, they are driven by the need for security for everyone. This includes interpreting the past to understand how a nation has arrived at its present position, knowing the present and seeking to influence the future (Williams, 2013: 1).

2.10 CONCLUSION

In this chapter, the background of where South Africa's water comes from was addressed, as well as projects by the DWS to ensure that South Africa has secure water supplies in the future. Governance plays a significant role in getting clean drinkable water into the tap with managed infrastructure to process or treat used water to return it to the river systems for re-use downstream. This is where local municipalities are playing a crucial role, and according to the AG reports, many municipalities were found wanting in this regard both in terms of the supply of potable water and wastewater treatment and management. It is evident that should this trend persist, South Africa's future may be compromised. In the process of attempting to identify poor management practices at local government level as a threat to water security, it has become evident that in cases where municipalities fail to render safe drinking water and dispose of wastewater responsibly in accordance with safe environmental practices, as discussed, those municipalities are in breach of Section 24 of the Bill of Rights: "Everyone has the right-

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that -

(i) prevent pollution and ecological degradation.

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use

of natural resources while promoting justifiable economic and social development" (South Africa. Constitution of SA Act, 1996: 12).

Climate change compounds the urgency with which these problems need to be addressed to get South Africa to a position where there is ideally a buffer between

consumption and supply, be it through further infrastructure development or enforced changes in consumption patterns. Water, food and human security are joined in a nexus, bound together, where the absence of water has a direct impact on food and human security.

Given worldwide trends, the effects of climate change will become an unpleasant reality for South Africans and the region. The poor will find themselves most vulnerable to the impacts of climate change first, as they will not have the means to ensconce themselves against the fate that is eventually awaiting everybody.

In Chapter 3, the theory of management is explored using an early pioneer in management studies, Fayol's management theory as a cue. The chapter expands on theoretical themes in the field and adaptations made by theorists, in understanding past and current management approaches which may have a bearing on this study and the chosen case. Within the ambit of a qualitative approach, this explorative and descriptive chapter touches on evolving themes based on the array of literature consulted in making the connection between management theory and the current state of water management in South Africa.

3

THEORY OF MANAGEMENT

In 1980 Boutros Boutros-Ghali commented that "*The next war in our region will be over the waters of the Nile, not politics"* (Acemoglu, Golosov, Tsyvinski & Yared, 2012: 284).

3.1 INTRODUCTION

Back in 1982, fresh out of school, the researcher was introduced to Fayol's management principles as a learner miner at the age of 18 on Harmony Gold Mine (Rand Mines) in the Free State. Fayol's management activities remained with the researcher over the years as the cornerstone of his personal management repertoire. These management principles and activities are easy to comprehend, easy to apply and easy to transfer as a management philosophy to subordinates so that they too can take ownership of their work in a structured manner. As a tool, Fayol's management principles aid to give structure and assist one in finding a starting point during the initial onset of gathering information before commencing with an assignment or executing a task. It provides a template in which to feed information pertaining to planning (forecasting), organising, commanding (leading), coordination and control. Control closes the loop to make sure the task was executed as directed and in many instances this function is the one most neglected. It is within this framework, that the researcher opted to use Fayol's management theory as the benchmark since the lack of service delivery at local government level relates to poor management, or lack thereof, in all its dimensions.

Against this backdrop, a variety of publications on the evolution of management theories, from early groundbreaking approaches based on the nature and causes of wealth generation, to the era of the industrial revolution, preceding the period during which traditional management theories became prominent, are still relevant today. This study utilised some of these insights as they could benefit the study.

Given the existence of earth's first humans (Kwok, 2018: 29), the concept of managing and mobilising individuals to achieve scheduled goals is central to man's existence on earth. The hunter-gatherer, a prehistoric culture, is an excellent example of a situation in which tribal survival was ensured by the coordination of hunting and gathering abilities of the tribe. The coordination of skills and resources to achieve a common goal can be found in examples such

as the Chinese who built the Great Wall, the Egyptians who built the pyramids and the Romans who built their sophisticated towns with roads and aqueducts (Kwok, 2018: 29).

The historians of the evolution of management have pointed out that it is a much harder task to "trace the formative thinking of the major contributors to our profession, especially its founders" (McMahon & Carr, 1999: 228 as cited in Dent & Bozeman, 2014: 148). By comparison, much less time has lapsed since the beginning of modern management thought, as opposed to the era when the first pyramids were built. The profoundly instilled nature of the frames of reference makes it impossible for historians to examine the first appearance of management elements. For example, Whiting (1964, as cited in Dent & Bozeman, 2014: 148) identified the theory of management and the historical roots of the practice as a mystery that would be unravelled at the proper time from independent study. However, such research has not yet been carried out (Dent & Bozeman, 2014: 148).

The belief is expressed that executives serve the primary constituency as policymakers, as decision-makers, as role models, as innovation facilitators, as employee motivators, and their sustained growth is an undertaking of the utmost importance in the field of management (Mabey, 2007: 1-18).

3.1.1 Behavioural management theories

Behavioural management theories originated and developed in the 1920s and 1930s and grew further into the mid- to late 20th century. In this period, theories gained traction in contingency-based systems developed in the 1990s when companies needed to adapt continually to remain competitive and relevant. Advanced systems were accepted to help executives make quicker and better decisions. At the end of the 20th century, quality management saw the light. The focus on customer satisfaction and delivering high-quality goods and services became important (Kwok, 2018: 29).

Theory is an integral part of growth and progress. From ordinary people to Nobel Prize winners, everything people do or think or the way in which they interact or the lens through which they see the world, stems from theories. Theories depict how people perceive things work. In principle, theories represent their world view of things around them and the relationships these have with one another. The problem is not that theories are being used to explain how the world works, but the accuracy and relevance of these theories within the environment they function in and how to relate to them (Mathieu, 2016: 1132). Van de Ven (1989: 486, as cited in Mathieu, 2016: 1137) reiterated his thoughts, noting that excellent theory is realistic simply because it advances knowledge within a field of science, directs research into critical issues, and educates a profession. By focusing on the historical impact

on the practice of management theory like Fayol, provides the basis for future research by business and management historians (Smith & Boyns, 2005: 1317).

Mabey (2007: 1-4) suggested that a solid management theory is still lacking even today. Through their research, scholars have continued to test a broad spectrum of hypotheses (economic, sociological, psychological, institutional, to name a few) and a range of methodologies (positivistic, ethnographic, interpretative, among others) in their attempt to explain the rationale behind the hypotheses. It made for vivid and thrilling commentary in their search to understand management development. Such parallel work has the downside that it has often failed to cross-fertilise and inform new research. In the worst scenario, scientists are so committed to their preferred paradigms that they ignore other contemporary research results (Mabey, 2007: 1-4).[5] For management practitioners, this might seem like intellectual infighting between scholars. Management development is an area that is especially susceptible to anecdotal advice from non-scholars. Using applicable methodologies and analysis techniques to test such justifications, the rhetoric and the actual value of multiple management implementation programmes can be a welcome contribution to those responsible for planning, commissioning and reviewing these approaches (Mabey, 2007: 1-4).

Similarly, the principle of development of management, whether in the private or public sector, is not self-evident, nor is it the basic principle of management. The semantic root is instructive, as it conveys the social division of 'management' as a conflicting process. In other words, it is a mechanism in which a person assumes accountability and attempts to control an important but willing and possibly resistant resource (Willmott, 1997: 163 as cited in Mabey, 2007: 1-22). Willmott concluded that this hierarchical division of labour is neither universal nor unavoidable but owes its nature to historical and political mechanisms that define and delegate managerial functions to a privileged social class of individuals (Mabey, 2007: 1-22). Over the years, management theories have evolved and become multifaceted. The emphasis shifted from behavioural science to the organisational and quality assurance arena (Kwok, 2018: 28).

3.2 MANAGEMENT AND LEADERSHIP

A manager in a traditional organisation is accountable for functions such as planning, organising, controlling, budgeting, staffing, problem-solving and other essential duties needed to run the company. On the other hand, a leader typically does not perform well in the

[5] On the rise of paradigms, adherence to and advocacy of paradigms and their role in science, see T.S. Kuhn (1968). *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press. The notion of paradigms, the exact meaning of the term and the contestation around clashing paradigms sparked an intense debate that still plays an important role in the (social) scientific world (Honderich, 1995: 451).

management role described above, but rather offers a vision of what needs to be done and how it should be done to improve the organisation's performance (Bertocci, 2009: 30).

It is essential to emphasise the differences in what the industry currently perceives as management qualities and leadership qualities. The two concepts are intertwined in the context of addressing the research question. However, whereas leadership will be touched on, the focus will be on management and the theory of management. It is posited that within the confines of this dissertation, the difference between leadership and management is highlighted. Although these are two different concepts, when deployed in unison the intended outcome in terms of strategic direction, deliverables, compliance with governance and overall employee satisfaction is more effective. By contrast, when leadership and management are deployed separately from each other, the end result is usually less favourable.

Management involves doing things effectively through individuals to achieve desired outcomes. Management is, or should be, closely related to attaining (well-set) objectives. In addition, management needs a combination of leadership, communication and people skills (Luke, 2011: 93). A manager without leadership skills is like a ship sailing without a gyroscope and a compass. In that case, the manager is merely a bureaucrat who moves paper and handles the daily activities and orders of those in higher positions (Luke, 2011: 93)[6].

Proper management brings about order and consistency to an organisation and aims to remove often unpredictable circumstances that threaten its very survival. Good management practices provide order and continuity in the quality and productivity of goods or services (Bertocci, 2009: 24-25). Proper management adds value to end-user service delivery and satisfaction.

Management as a theoretical term with functional consequences underwent a paradigm shift, emphasising new forms of management professionalism (Hood, 1991; Quinn, 1992, Prahalad & Hammel, 1994; Hales, 2005; Brunsson, 2008; Birkinshaw, 2012, as cited in Voxted, 2017: 269). Management or leadership is a distinct discipline, separate from the careers of employees. If management is an indirect function, its purposes are setting the framework, setting the direction, and connecting workers with the organisation's vision and intent. The roles of the manager are based on strategic management and implementation of change (Voxted, 2017: 269). On the other hand, it is emphasised that activities related to the administration of day-to-day operations and vocational supervision are often conducted at the

[6] It is no small wonder then that the need for sound management approaches has been identified in organisations other than private companies or state-run entities and public-private partnerships. In terms of “modern” management debates, J.R. Beishline identified the importance of management and sound management approaches in the military. For a useful early contribution in this field, see Beishline (1963).

management level and executed by the workers themselves. This has also paved the way for ideas such as team management, self-management and empowerment (Kinlaw, 1995; Kelly & Allison, 1999; Seers, Keller & Wilkerson, 2003; Osborn & Brown, 2005, as cited in Voxted, 2017: 269).

With the emergence of modern public administration, the process of administrative professionalisation is increasingly relevant in public management (Hood, 1991, Steward & Walsh, 1992, Ferlie, Ashburner, Fitzgerald & Pettigrew, 1996, Gruening, 2001, as cited in Voxted, 2017: 269). All of these trends point to a development that is different from the principles of Fayol's administrative leadership, where the manager is directly involved. Management has now become a symbolic activity and the function of the manager is to motivate and contextualise employees' autonomous contributions and coordinate their actions (Voxted, 2017: 269-270). The concept, 'the manager', remains in the picture when it comes to the level of service delivery or the final target set.

Another factor that separates contemporary management from Fayol’s ideas is leadership theory, stressing employee participation and autonomy (Voxted, 2017: 270). Management theory found some of the first of such comparisons much earlier than the 1980s. Examples are Douglas McGregor's Theory X and Theory Y (McGregor, 1960, as cited in Voxted, 2017: 270) and Kurt Lewin's distinction between laissez-faire management, democratic management and authoritarian management, with specific focus on discrepancies between democratic and authoritarian management. Lewin's distinction is undoubtedly skewed towards the ideal of democratic management (Lewin, Lippit & White, 1939, as cited in Voxted, 2017: 270). The laissez-faire leadership style is rejected for lack of leadership or even the total absence of leadership. In laissez-faire leadership, the manager can become too ’distant’ or ‘absent’ to effect good performance.

The importance of leadership cannot be overlooked, nor underestimated when the theory of management is debated. In the 1980s, the normative aspect of management theory became more apparent. New strategies suggested that modern management presupposes leadership and that decentralisation, team organisation and self-management will replace direct manager involvement (Kelly & Allison, 1999; Cordery, 2005; Sorensen & Triantafillou, 2010, as cited in Voxted, 2017: 270). Management theory has been influential since 1980, although the idea of management paradigms varies in several respects from Fayol's 1916 principles (Fayol, 1954: 19-40, Voxted, 2017: 270).

Leaders tend to understand exactly what needs to be done, how it will be done, who will do what, what the result will be and why it is necessary (Bertocci, 2009: 17). Leaders tend to have an inherent capacity to see the larger picture, to be willing to delegate the job, to

encourage followers to accomplish challenging and optimistic goals, and magnetically attract people to want to perform their part of the project efficiently and successfully (Madsen, 2001: 14). They have a remarkable talent for inspiring others to get on board. Particularly in this sense, leaders can express their vision: “This is where we are, and this is how we will get there” (Bertocci, 2009: 17). Leaders are individuals who encourage or persuade others to do what they would not do without the influence of the leader (Madsen, 2001: 11, Bertocci, 2009: 18).

Leadership is about the dream, big picture expectations and dealing with uncertainty while delivering positive results. As the business world has become more sophisticated, dynamic and unpredictable, leadership has become critical (Bertocci, 2009: 25). The same can be said of the administration of state institutions at various tiers of government. It has been recognised even earlier in this modern era that significant improvements in organisational architecture, structure and leadership are becoming necessary for survival (Beishline, 1963, as cited in Bertocci, 2009: 25). In conditions of uncertainty, it is no longer possible to use today’s science, based on yesterday’s experience, to predict the needs of the future (Turton, 2007, as cited in WWAP, 2012: 140). The challenge of predicting demands during an era of accelerated changes adds to the complexity. Dealing with organisational transition needs strong leadership (Madsen, 2001: 32). Organisational leadership includes two primary components of action. The first is directing the organisation to address continuous change. Such an environment requires leaders who welcome change, who deal with it by clarifying and sharing strategic purpose or vision and who build their organisation and develop their community to suit opportunities and challenges. The second is having management expertise to handle organisational change. This means finding and recruiting managers who can provide corporate guidance and direction as never before (Bertocci, 2009: 25).

Finally, Kirkpatrick and Locke discussed some of the characteristics seen in leaders, presenting a management model of five elements found in leaders, namely:

- “Achievement: A leader’s need to achieve is essential to complete challenging projects, obtain work and educational experiences, and to start and finish projects.
- Ambition: A leader’s dream drives learners (workers and employees) to set challenging goals to achieve.
- Energy: A leader focuses energy on successfully handling an intense and demanding project.
- Tenacity: A leader demonstrates staying power in completing challenging projects and overcoming sizeable obstacles.

- Initiative: A leader is proactive rather than reactive, seizing opportunities and not hesitating to initiate action to correct identified problems" (Bertocci, 2009: 27).

3.2.1 Differences between management and leadership

One of the most significant disparities between managers and politicians is not only in leaders or managers themselves but in their followers. In leadership, followers either respect or do not respect the leader. Workers in management usually lack the same versatility, as they risk losing their work if they do not show respect (Bertocci, 2009: 32). This argument can, of course, be contested with various examples of leadership in military situations where representatives of the army are unwilling or reluctant to obey the leaders; yet based on this distinction, it is clear to see that followers empowered to assume a particular function tend to be more efficient and productive than followers who merely hold a position under immediate and close supervision.

Similarly, Matthews and Brown have done valuable work (1989, as cited in Bertocci, 2009: 32) in this respect (leadership and military management). In an essay titled "*What Leaders Actually Do*", Kotter claimed that for many reasons, management is separate from leadership, which is not what most people think (Bertocci, 2009: 32). He assumes that leadership and management are two entirely different concepts of operation, each with distinct roles and features (Madsen, 2001: 5, Bertocci, 2009: 32). According to Kotter, one of the crucial differences between management and leadership is embedded in their fundamental and primary roles. While management addresses the complexities of personnel, organisational architecture, planning and implementation, scheduling, input and performance monitoring and a wide range of human resources problems, leadership is concerned with vision, big picture issues, transformation and what is awaiting the company and the markets in the future (Madsen, 2001: 18, Bertocci, 2009: 32).

3.2.2 The advent of scientific management theory

A social dimension shaping a management system was the use of a scientific approach to improving work efficiency (Dent & Bozeman, 2014: 154). Science and business became allies overnight; their existence and development relied on each other. The social gold standard was to be considered 'scientific' during this time. 'Science' had great social significance (Dent & Bozeman, 2014: 155)[7].

[77] Later on, works on management for public consumption (and certainly as a means of profit-making) for a growing readership of young managers became less scientific and commonplace, even pedestrian. See for example Flanagan and Finger (2000).

The early emergence of management theory can be traced back to the idea of a hierarchical organisation, initiated at the turn of the 20th century by Max Weber (1958) and expanded by later classical thinkers, including Taylor, Frank, Gilbreth, Fayol, Gantt and Parker Follett, among others (Weymes, 2004: 85-86).

Since there was so much innovation in applying science to real challenges, the prevailing opinion of the day was that every question could be addressed and overcome using scientific principles (Dent & Bozeman, 2014: 155). The positivist approach to (management) sciences was prevalent at the time. One might argue that management has particular significance. However, the entire future of management theory depends on reinventing itself to face this challenge (McDonald, 2011: 798).

Weymes (2004: 87) argued that as industrialisation gathered momentum and bourgeois capitalism developed, Western societies' social landscape changed during the early 1900s. Organisations have been characterised by the following:

- A hierarchy of authority,
- Impersonal rules that define duties,
- Standardised procedures,
- Promotion based on achievement, and
- Specialised labour.

Mainstream management theory centred on trends of social behaviour predominant in the early 1900s when society was in flux from a rural to an urbanised industrial society. Incomes rose, and a consumer culture developed rapidly (Weymes, 2004: 87). Success was associated with generating personal wealth, thus providing the reason for Weber's argument that fulfilment of own needs had replaced individual responsibility for society and social mores. The 1900s' social actions may have validated bureaucracy and inspired the transition to scientific management. The 1900s' management theory was based on the ideology that mirrored the social behaviour of the time and emulated the austere ideals of Calvinist culture (Weymes, 2004: 87). Weber claimed that bureaucracy could achieve the maximum effectiveness and the most rationally proven way of imposing control over people and organisations (Weymes, 2004: 85-86). Taylor (1911, as cited in Weymes, 2004: 85-86) adopted this theory and developed the management science approach, suggesting that jobs should be defined, and operating practices improved and rationalised by rigorous study and scientific analysis. The organisation's motivation was productivity to increase the output and wealth of its members. Employees were not to be trusted, and stringent steps had to be implemented to ensure that their activities led to increased performance. The command and control age had entered the workplace. Human rights were neglected, as were environmental

concerns, with several factories making themselves guilty of land, water and air pollution during this era (Weymes, 2004: 85-86).

McGregor (1960) questioned this approach (Weymes, 2004: 85-86). According to conventional wisdom, workers must be inspired by extrinsic incentives, punishment and tight supervision. McGregor indicated that staff should be fundamentally motivated by exciting work and tasked with controlling and directing their actions (Weymes, 2004: 85-86). This approach has been known to be a 'soft' leadership component of real organisations that pursued financial profits and efficiency through particular systems and processes. Though this was a period of massive industrial prosperity in the West, such 'modern' and humane organisational design approaches were rejected. Only later, at the beginning of the 1980s, did the Asian economies experience intense strain and management literature started to concentrate on 'soft' skills (Weymes, 2004: 85-86).

Throughout the early 1980s, the publication of Peters and Waterman (1982, as cited in Weymes, 2004: 86), *In Search of Excellence,* soared to the peak of the world's best-selling chart. The corporate environment adopted a distinct approach to management. An analysis of Deming (1952, as cited in Weymes, 2004: 86) was shown on American TV in 1979, and the 'saviour' of Western institutions, unexpectedly, was the concept of *Total Quality Management* (TQM), (Weymes, 2004: 86). Quality circles were set up, supervisors replaced self-management teams, and it was proposed that corporate barriers be eliminated. Deming (1982:23 as quoted in Waymes, 2004: 86) explained the TQM concept in 14 points, which aimed to shift the principle of management from a mechanistic approach to a people-centred approach. Organisations were urged to create purpose, drive out fear, conquer interdepartmental barriers and educate and train people within the organisation to instil trust (Weymes, 2004: 86).

In 1985, the *Baldrige Quality Awards* were developed to improve profitability and to focus on customer service and quality assurance. These were the two key areas where Western industry failed to compete with its Asian counterparts (Weymes, 2004: 86). Globally, these differences were supposed to adjust metrics for the better. Initially developed in America, the incentives, which allowed companies to adapt to a participatory style of management involving all employees, were soon adopted in most Western countries. When writing *The Fifth Discipline*, Senge (1990) proposed a paradigm shift in studying organisations (Weymes, 2004: 86). The scientific management approach viewed the organisation as a closed system, not communicating with its surroundings. Senge's research questioned this claim by demonstrating that companies interact with their environment and should therefore be regarded as open systems (Weymes, 2004: 86). Senge's solution came as a reminder that

the socio-cultural landscape is complex, flexible and that culture – especially the business and economic landscape – is interactive, multi-layered and web-like (one action overlap others and all are interactive)[8].

In 1996, Kaplan and Norton published *The Balanced Scorecard*, a systematic method for assessing an organisation's performance in the four areas of:

- Customer service,
- Operation management,
- Generating knowledge, and
- Financial results (Weymes, 2004: 86).

Even today, the method remains popular as a metric for performance measurement and behaviour management, although that was not its intention. In the original paper (Kaplan & Norton, 1992, as cited in Weymes, 2004: 86), the writers proposed that if an organisation followed customer expectations, regulated the efficiency of its processes and encouraged knowledge generation through innovation and learning, profitability would follow. For Kaplan and Norton, financial returns would indicate the model's success. However, for executives, 'return on investment' remained the measure of feedback, the standard to be controlled (Weymes, 2004: 86)[9].

As the 21st century approached, the concept of corporate citizenship captured the imagination of not only business members, but also of society (Weymes, 2004: 86). Perhaps the selected few saw themselves as profit-generating and wealth-enhancing organisations. The government's power of action against unethical conduct emphasised the value of corporate responsibility, ensuring that organisations focused on social, environmental and financial returns (Weymes, 2004: 86).

While the terms 'Corporate Citizenship', 'Corporate Social Responsibility' (CSR), 'Sustainability' and 'Total Ethical Management' are marketed as the new management mantras and attract the interest of several big corporations, the impetus behind each term is comparable to becoming a responsible corporate citizen. The Brundtland Report's concept of sustainability (1987, as cited in Weymes, 2004: 86) offers a concise description of the chief executive's challenge: “economic development that does not promote the ability of future

[8] In a slightly different context, Keulder (1996) argued that global economics, finances, the world of production and profit and in the relations between structures, systems and nations one finds interactive web-like dynamic layered structures.
[9] Some more research evolution and applied work in the field of performance evaluation of state-owned entities and state departments in South Africa has been done since then (compare Mariaan Roos et al, 2008 onwards).

generations to achieve and enjoy the same level of welfare or standard of living as the present generation" (Weymes, 2004: 86).

Given the plethora of papers and books appearing over the years to promote this 'new' management strategy, companies and chief executive officers (CEOs) are still constrained by return on investment and shareholder value. Hard performance numbers and results tend to determine and characterise success, while only passing remarks are made on an organisation's effect on society and the climate. With the increasing popularity of triple-bottom-line accounting, the significance of future financial returns may decline (Weymes, 2004: 87). The CEO of today's knowledge organisation, therefore, faces a dilemma: generating statistics by solely implementing behaviour management mechanisms and processes or developing an environment that encourages innovation and ingenuity, contributing to strategic advantage (Weymes, 2004: 87). Creative settings cannot be controlled, and because they allow people to articulate their own identity, they can clash with the systems and processes required to 'make numbers improve' (Weymes, 2004: 87).

Today's world is far from the 1900s. The service economy succeeded the industrial economy and has now been succeeded by the knowledge society (Weymes, 2004: 87). Employees have become intellectual property developers of the organisation rather than human capital — organisations are now buying brainpower, not brawn! Globalisation and automation have transformed the way industry is conducted today, resulting in changing social behaviour. Individuals today are well educated, have a higher standard of life, and have a broader world view than their ancestors a century ago. Nevertheless, contemporary organisations are still controlled according to the social behaviour of the 1900s (Weymes, 2004: 87).

Considering the above, it is vital to refer to today's needs to satisfy the demand from current management expectations and the way in which this relates to the delivery of services in general in the public sector, but mainly how it relates to the service delivery of local governments[10]. The competence profile of the civil service represents the national assessment of expertise according to the NPC (2013: 45). Good-quality physicians, engineers, information technology professionals, forensic specialists, investigators, managers, accountants, judges, attorneys, consultants and curriculum advisors are in extreme shortage. Moreover, the management ability of senior workers working in a diverse and competitive corporate, political and social landscape needs to receive considerably more attention. To counter the lack of

[10] The needs and challenges of public service delivery are not only a challenge for so-called developing countries. In an informative work, Cloete (2000) pointed out that despite significant economic growth and inroads in the global market, East Asian countries faced numerous governance and service delivery challenges (including on local levels of government) even while registering good economic growth.

technological and management expertise, the government needs to take a long-term look at improving the knowledge base required to overcome these shortages. Through career options, mentoring and closer cooperation with universities and management schools, progress is sure to be made in this regard (NPC, 2013: 45).

The government should handle its resources, infrastructure and human resources better. The NPC (2013: 46) states that there is a need for improved control of state structures, including mediating agreements between districts and local municipalities where there is disagreement or dispute in the allocation of roles and services. Provinces will need to concentrate more strongly on their central role to build the capacity to assist in monitoring local governments (NPC, 2013: 46).

Realising the connection between achieving the desired results on time and a budget is essential. To accomplish the above, time, effort, resources and finances have to be expended wisely to yield the desired results. Reality currently paints a different picture in local government (CoGTA, 2019; Makwetu, 2019b: 2). Senior management has been unable to develop, implement and monitor effective internal control mechanisms and procedures, including corrective action, in most local government entities around the country (Makwetu, 2019b: 10).

Many challenges demand tremendous attention being paid to all three levels of government, including a vital capacity deficit, complicated intergovernmental structures, high rates of corruption, insufficient accountability, limited legislative scrutiny and oversight management, and a long history of blurring party-state boundaries. These issues require honest assessment, careful planning and efficient management (NPC, 2013: 49).

The AG's Report (2019: 20) explicitly indicates that the current repercussions at local government level can only be modified by taking the lead in steering the public sector towards a drive to embrace clean administration on a national scale. Leadership sets the tone for any organisation. If an organisation's members are unethical, lack leadership, integrity, and compliance, and cannot ensure transparency and accountability, it will flow to the organisation's lower levels. Inevitably, organisations struggle to overcome a culture lacking control and condoning arrogance and reluctance to act when events and conditions determine (Makwetu, 2019b: 20).

The AG (2019:21) is hopeful that the existing local government can be changed if the representatives at all three tiers of government concentrate on core issues:

- Posture at the top – ethical leadership, proper management, and accountability.
- Ability and stable management – free from political interference.

- Enabling and relying on dependable financial and performance management systems.
- Reliable, effective and quick monitoring of irregularities.

These issues would be essential to successful management and successful local government (Makwetu, 2019b: 21). Officials lacking the requisite experience, qualifications or understanding of management and monitoring standards for correct management information in applying successful performance measures have been identified as one of the reasons why service delivery is so poor at local government level and unable to improve (Makwetu, 2019b: 10). The AG again expressed concern about the Free State's local authorities' situation, adding that: “The Free State local government environment displayed a total breakdown in internal controls as the province’s political and administrative leadership, yet again, exhibited no response to improve its accountability for financial and performance management” (Makwetu 2019b: 13).

It would seem that the organisations and systems of an industrial-technological society restrict the availability of alternative options significantly. When people are more self-centred, they tend to abandon their responsibilities to participate in government and other social activities (Weymes, 2004: 88). In the case of local government, this statement by Weymes drives at the heart of the problem about poor service delivery or lack of service delivery in South Africa.

3.3 THEORY OF MANAGEMENT ACCORDING TO HENRY FAYOL

A theoretical framework for this study was developed by using Fayol’s management theory as a basis.

Some management thought scientists believe Fayol wanted to attract graduates, educators, and practitioners in management. This is particularly valid, as many management authors (Wren, 1994; Fells, 2000 Bartol et al., 2001; Rodrigues, 2001; Breeze & Miner, 2002, Wren et al., 2002: Parker & Ritson, 2005b; Brunsson, 2008, as cited in Pryor & Taneja, 2010: 489-490) assume that his work sets the basic principles and context for the theory of management and that the framework of Fayol remains the cornerstone of the theory of management today. Fayol's approach still has relevance today; the strategy can help explain the lessons learnt as well as offer practical metrics for water conservation as a scarce resource.

Wren and Bedeian (2009: 227) stated that Fayol was a strategist before the term became popular. As keen students of management practice, Wren and Bedeian (2009: 227) noted the following: "Whether they believe it or not, most managers today are essentially Fayolists”. Therefore, Fayol is regarded as "Father of Modern Management" (Wren & Bedeian,

2009: 227). Fayol believed that planning, organising, commanding, coordinating and controlling, as well as management development, rather than technical preparation, were core elements of success. Wren and Bedeian (2009: 234) were correct in saying that history has proven that some management scholars have overshadowed Fayol's research over the years. Only after his death did he receive the recognition he deserved for his role in the ongoing development of management thought.

The reviewed literature (Wren & Bedeian, 2009: 227; Pryor & Taneja, 2010: 489; Surbhi, 2018) confirms that Fayol's management theory can be extended to any enterprise, unlike other management theories such as that of Taylor, which concentrated above all on the factory floor scale (Surbhi, 2018). Fayol's work and insights become relevant, as the researcher is not dealing with water scarcity only in this study. The delivery of quality water at local government level is a priority. If service delivery (and this includes the provision of quality water in sufficient quantities at local government level) in times of water scarcity cannot take place, the South African government's NDP, conceived in 2011, will not succeed, nor would communities benefit. Non-delivery will lead to dissatisfaction and protests and have an impact on socio-political stability in the affected communities.

In the research process followed in this study, Fayol's management theory was used to illustrate the importance of a practical top-down management approach when it comes to government structures such as local government. All government structures are formal, frequently rigid and structured hierarchically and have clear guidelines on desired outcomes, goals and objectives and who should report to whom on which matters. Fayol's management theory is ideally suited to a top-down bureaucratic command structure like any public service organisation, whether at national government level or at local government level, where service delivery should be the desired end state. Policy and the desired end state are formulated at the top structure of the organisation, and the lower structures ensure adherence to policy and deliverables.

Fayol claimed that all organisations were divided into six groups, at least in the private sector: technological, economic, financial, security, accounting and management (Fayol, 1954: 3). This research by Fayol concentrated on the principal factors influencing corporate management. More attention has been focused on the other five areas of management activity than on management. Still, how organisations are managed has a greater impact on everyday life than the other five areas (Dent & Bozeman, 2014: 146).

Modern management, in its approach to the employed workforce, is primarily designed to operate objectively and instrumentally toward human 'resources' (Dent & Bozeman, 2014: 147)

3.3.1 General and industrial management

The theoretical point of departure for Fayol is the possibility of dividing organisational activities into six categories. Fayol (1954: 3) described these activities as follows:

- Technical events (production, manufacturing, adaptation).
- Commercial activities (buying, selling, exchange).
- Financial activities (search for optimum use of capital).
- Security activities (protection of property and persons).
- Accounting activities (stocktaking, balance sheet, costs, statistics), and lastly
- Managerial activities (planning, organisation, command, coordination and control) (Wren, 2001: 482-483; Voxted, 2017: 258).

Based on this division, Fayol summed up management's role as:

- Planning (Forecasting)
- Organising
- Commanding
- Coordinating
- Control.

Forecasting implies having the means of analysing the future and drawing up an action plan. Organising involves establishing the undertaking's internal structure, material and human resources. Commanding implies controlling the personnel’s performance. Coordinating includes linking, unifying and harmonising both action and commitment. Control ensures that everything happens in compliance with laws and the articulated direction (Fayol, 1954: 6).

Using this definition, Fayol divided management into five subsidiary management functions:

1. Planning involves evaluating and parametric modelling of future operations of the organisation. Management must ensure that the company is driven by an action plan that takes into account the present situation and recommends strategies to address future challenges. Planning is focused on the resources of the enterprise (buildings, infrastructure, personnel, manufacturing capacity, capital, markets), the internal climate of the organisation and its external environment, and potential demands and needs resulting from technological developments, evolving sectors, political and economic activities (Voxted, 2017: 258).

2. Organising is a matter of securing critical prerequisites in terms of facilities, skills, financial services and human capital. Although scheduling is a forward-looking, undoubtedly strategic process, the organisation attempts to establish workflow in its activities. The work should be organised (Fayol, 1954: 53–54) by paying attention to the following examples:

- Ensuring that the plan is carefully prepared and strictly implemented;
- Ensuring that human capital and physical organisation are compatible with the objectives; resources and requirements of the organisation;
- Establishing a single, skilled and energetic guiding authority;
- Harmonising operations and coordinating efforts;
- Formulating clear, distinct, accurate decisions;
- Appointing the best fit for the job – each department must be headed by a skilled, energetic individual; each worker must be in the position where he or she can render the best service;
- Defining duties clearly;
- Encouraging initiative and responsibility;
- Having fair and appropriate compensation for the services provided;
- Making use of sanctions against errors and faults;
- Ensuring the maintenance of discipline;
- Ensuring that individual interests are subordinated to the general interest;
- Paying particular attention to the unity of command;
- Ensuring that supervision takes place at both the resources and human resource component;
- Having it all under control; and
- Addressing excess and unnecessary regulations, red tape and administration (Fayol, 1954: 53–54)

3. Giving orders (command) is the method managers use to control staff and the work process. It also forms a nexus in communicating a shared vision, policies and set strategies to achieve specific goals, particularly in an environment where rigorous service delivery is necessary. This appears to be of considerable interest for this study's immediate sense and scale. The extent to which the directives are executed depends on the authority granted to the manager and the degree of accountability displayed by the workers about the manager's guidelines and the completion of tasks (Voxted, 2017: 260). Obedience is equated with responsibility arising from the employee's ownership of the required discipline (Voxted, 2017: 260). However, this assumes that the manager is professional and adheres to the laws and regulations that relate to the labour market in general and the workforce. Despite Fayol's wide-ranging abilities given to a manager, they are obligated to recognise and uphold high moral and ethical principles in the operations and to respect existing laws (Voxted, 2017: 260). This is often reflected in Fayol's points as preconditions for the full impact of his directives, i.e. the need to retain discipline among employees. The manager must be in charge and do the following (Fayol, 1954: 97–98):

- Have a thorough understanding and knowledge of employees;
- Remove incompetent members from the organisation;
- Be well versed in contracts binding on the company and its employees;
- Set a good example to all;
- Conduct regular audits of the organisation (Roos & Stainbank, 2017: 125ff) and use summary charts to further this;
- Bring together section heads and managers through conferences to ensure unity of direction and focus of effort;
- Avoid becoming engrossed in detail – focus on the big picture; and
- Create a sense of unity, energy, initiative and allegiance to the organisation among the employees (Fayol, 1954: 97-103; Voxted, 2017: 260).

4. Coordination is the job of harmonising all the organisation's operations in such a way that work processes are made more accessible while at the same time pointing to the organisation's objectives. The following characterises a well-coordinated organisation (Fayol, 1954: 104):

- Each department operates in harmony with other departments;
- Divisions and subdivisions in each group are accurately informed of their share of the daily activities and the mutual assistance they are expected to provide to each other; and
- The various departments and sub-divisions' operational plans are continuously consistent with the bigger picture.

In other words, teamwork is about adapting activities to the environment, other components, as well as external interaction. While the task of organising the work is inward-looking inside the organisation, teamwork travels around the entire organisation, according to Fayol (Voxted, 2017: 260 - 261).

5. Control is about monitoring and ensuring that plans and decisions are carried out in a manner that is appropriate and based on the direction given by management. Control is practised at all levels of operation (Fayol, 1949: 107ff).

- Control over employees is exercised to ensure that staffing plans are consistent with overall policies and that human resources are employed in the best possible manner;
- Control of company operations required, i.e. control of input and output, in both qualitative and quantitative terms, financial control of prices, and contribution margins, and verification of the correct and agreed on compliance of orders is expected;
- Control of production and the use of resources (materials, real capital and human resources) is maintained to ensure compliance with technical requirements;

- Control is maintained over the use of financial resources, including continuous monitoring of consumption and access to financial resources and the current solvency and financial health of the organisation;
- Control is exercised to deal with market circumstances and the internal security and integrity of the organisation. The first part concerns market surveillance and the assessment of the situation. As for the second stage, internal security and integrity of the firm concern matters such as surveillance to counter industrial espionage or attempts at hostile takeovers. It may also be less dramatic for the company to ensure that patented rights, intellectual capital or competition clauses are not infringed in any way;
- Finally, both the external and internal environment are controlled to guarantee that continuous monitoring is feasible in the first place. An executive summary should be prepared that provides a quick, accurate and reliable image of the firm's situation in the areas under control, such as critical financial figures, staff statistics, sales figures, production outcomes, market analyses and contribution margin analyses (Voxted, 2017: 260-261).

To bring this home and relate the above to South Africa, Makwetu (2020b: 5) has reported that since the 2017/18 FY, overall internal controls at local government regressed by 19%. Similarly, basic financial and performance management controls regressed by 12% since the previous audit. It would appear that control as a management function at local government is lacking in various disciplines as a function of management.

Control is a managerial task, according to Fayol (1954: 107). Simultaneously, however, it is a role that can often and advantageously be delegated to operational staff through job categories such as ’controller‘ or ’inspector’. In certain situations, control is viewed as a matter of relatively routine operation, although it requires detailed knowledge of the situation under observation. Therefore, in some cases, it would be more appropriate to use trained specialists rather than assigning the work to the controller or inspector concerned (Voxted, 2017: 261).

Fayol (1954: 19-40) also established a series of 14 management principles to boost efficiency. These principles are division of work, authority, discipline, unity of command, unity of direction, subordination of individual interests to the general interest of the company, remuneration, centralisation, line of command, equality, order, initiative, secure retention of workers, and *esprit de corps*. Many of these principles still apply today, even though other leadership theories developed over the years (Francis, 2018).

Fayol's publication (1954: 43ff) primarily contains practical ideas reflecting the time and context of its period. Despite current management problems, these ideas have little or no significance to management practice today. For this reason, there is little inspiration for either

professionals or management scientists in general and operational management to apply them. There is no encouragement for either practitioners or managers in terms of general and operational management. However, by looking at management/leadership from a meta-perspective, something can be learnt from Fayol. New management theory, based on ideas such as distributed leadership, transformational leadership, self-management and e-governance, continues to ignore that leadership is all about labour division, day-to-day coordination of operations and control. These are some elements that Fayol highlighted in his 1916/1917 book (Voxted, 2017: 272).

Cognisance should be taken of the fact that despite the philosophy of management proposed by Fayol as discussed thus far, it will be challenging to deliver quality water to the people of South Africa in a democratic fashion. Crisp and articulated thought on the strategic direction, as well as the practice of effective management and leadership skills functioning in concert, is what will be required to ensure effective and efficient management of South Africa's water resources at all three tiers of government. For this reason, leadership and management development will play a prominent role in creating capacity for improved service delivery at ground level.

3.3.2 Training and development

How countries and businesses develop their management 'stock' is a handy indicator of the perceived importance firms attach to management and leadership, as well as the methods used to achieve financial results (Mabey, 2007: 1-3). In China, for example, the initial focus was on practical vocational training from the late 1970s throughout the 1980s. Focusing on management growth in the latter part of the 1980s became common practice and was accepted as a progressive policy initiative by the government (Wenming, 1984: 99-124, Mabey, 2007: 1-3). The immensity of this problem, as recognised by the Chinese government, was revealed when the Chinese Vice-Minister for Education calculated in 1988 that 400 000 state-owned enterprises (SOEs), 300 000 joint ventures and 200 000 township enterprises needed 2,7 million qualified executives (Mabey, 2007: 1-3). It was projected that by 1994 there would be only 500 people with the degree of Master of Business Administration in China (Southworth, 1999, as cited in Mabey, 2007: 1-3). Management development continues because of the increasing number of Chinese managers and executives taking business and management courses outside China, the participation of Chinese executives with their Western partners in joint projects and the rising number of Chinese people who settle in China as managers and executives, professionals and businessmen (Wenming, 1984: 99-124; Chow, 2004: 137; Branine, 2005: 471).

Management development is a significant sector, creating its own market worldwide. Government departments, educational colleges, training agencies, consultants, business schools and private universities are only a few entities benefiting from the continuing and increasing need to build a new generation of business leaders, senior executives and managers (Mabey, 2007: 1-3). Several years ago, global investment in management development activity was estimated to be in the region of $37 billion (Boyatzis et al., 1996, as cited in Mabey, 20017: 1-3), and it has since grown sharply. About 20 million man-days a year are expended in developed economies such as that of the UK on programmed management training, which may well be doubled if less formal development were taken into account (Burgoyne et al., 2004, as cited in Mabey, 2007: 1-3). It goes beyond indirect investment components, such as design and implementation time, incentive costs, educational initiatives and assessment exercises (Mabey, 2007: 1-3).

Employers in France have a compulsory duty to devote 1.5% of the gross annual payroll to vocational training. However, it is the employer who decides whether and on whom it is expended (Mabey, 2007: 1-4). Turning to the developing markets of central Europe, investments of individual businesses in training managers range from a few thousand US dollars to US $135 thousand in Romania and up to US $625 thousand in Slovenia (Gudic, 2001, as cited in Mabey, 2007: 1-4). Given the number of days expended on management preparation and the money spent on such programmes, there is an excellent drive to convince corporates that these are well-invested resources. Training days and budgets for growth are small measures of input. What is needed is a measure of the outcomes to ensure that the money invested is well spent. However, it is difficult to gather such concrete evidence of the efficiency and benefits of management development by itself (Mabey, 2007: 1-4).

There is lack of critical skills in the water value chain across different institutions (engineering skills, artisans, socio-economic, health, and management skills) (Water Affairs Department, 2013: 96). The Power and Water Sector Education and Training Authority (EWSETA) Business Skills Plan (2011-2016) identified significant capacity gaps in the DWS (which at the time was known as the DWA). Approximately 3 000 engineers (57% vacancy) were required, as well as approximately 7 200 sanitation and hygiene/environmental health professionals in the medium term. There was an urgent need for 125 new environmental health professionals and the upgrading of the skills of another 150. Of these, 1 400 were needed immediately, including 246 construction project managers, design managers, engineer managers and technical project managers (21% of the total technical management skills available). A long-term need for an additional 12 000 workers with development and financial management skills became evident, and an urgent need for 4 000 craftsmen and technicians was identified (Department of Water Affairs, 2013: 96).

This study has determined that based on the skills gap identified in the EWSETA Sector Skills Plan (2011–2016), the DWS made significant strides in addressing these shortcomings. The findings reported below are for the DWS and refer to employees of the Department. No data was available in terms of skills shortages at local government level; local government is the structure at ground level where service delivery fails or succeeds.

In respect of shortcomings mentioned in this review, the developments identified in the DWS's Annual Report for the FY 2017/2018 (2018: 15: 1) can be summarised as follows:

- The graduate training programme is essential for the recruitment, training and development of young professionals to resolve the twin challenges of skills shortages and succession planning in the Department.
- Since its inception in 2007, the Learning Academy has awarded 842 scholarships in the science and engineering fields at 22 South African universities. Of the 842 scholarships awarded, 410 were in the engineering field of study, 350 in science and 43 in surveying.
- The Learning Academy's approach to skills training begins at university level through the scholarship programme, and then the provision of experiential learning for students after completing their university studies.
- Experiential learning also offers incentives to graduates to fulfil the mandatory required registration with professional bodies.
- For the year under review, the Department had a complement of 267 graduates performing remunerated candidacy work (Annual Report Department of Water and Sanitation FY 17/18, 2018: 15).

The Department's emphasis was also on the education of senior managers to strengthen the competencies and skills gap found through the competency evaluations conducted in 2016/17. To this end, 107 senior managers attended training courses in management, finance, employee relations and leadership (Annual Report Department of Water and Sanitation FY 17/18, 2018: 15). During the same period, the DWS continued with the implementation of the Annual International Relations Implementation Plan. Through this plan, four young people benefited from the South African/Japanese relationship; they were trained in Japan and received master's degrees, three in engineering and one in international relations. Moreover, South Africa received support to the value of R55 million from the Japan International Cooperation Agency (Annual Report Department of Water and Sanitation FY 17/18, 2018: 15). This funding was aimed to set up a training centre to improve water capacity building in the water industry (including municipalities). South Africa received R2 million funding through Belgian collaboration to finance a pilot sanitation project for the Saldanha Bay municipality. Two memoranda of understanding were concluded with Spain and Hungary in the field of

water resource management cooperation (Annual Report Department of Water and Sanitation FY 17/18, 2018: 15).

The DWS has been active in developing comprehensive training programmes in accordance with the Departmental Workforce Skills Programme. The Department has assisted a total of 2 353 employees with training and growth initiatives, as reflected in the 2017/2018 Annual Report (2018:122). The Khaedu initiative has also been rekindled by the National School of Government, in addition to regular training and growth initiatives. Many members of senior and middle management in the Department have gained from this curriculum, which is aimed at improving and introducing transformation initiatives within their functional areas through various learning opportunities (Annual Report Department of Water and Sanitation FY 17/18, 2018: 122).

3.4 FAYOL'S CONTRIBUTION

Fayol's general and business management theories were based on contemporary cultural ideas and his own successful experience as a manager. Various publications note that the book by Fayol is focused on a systemic management approach (Carter, 1986; Parker & Ritson, 2005a; Wren & Bedeian, 2009; Parker & Ritson, 2011; as cited in Voxted, 2017: 265), and reaches the stage where the text is distinguished by a closely linked strategy similar to data collection described under grounded theory (Voxted, 2017: 265). Fayol's publication is a normative review, rather than an objective analysis based on his own lengthy and productive work experience (Voxted, 2017: 265). Fayol's work should not be seen as a matter of gathering evidence based on current scientific methodology. The publication's suggestions should be regarded as common sense and nothing more (Voxted, 2017: 265).

Fayol and Follett both achieved recognition as management professionals and writers, first in their own countries and later internationally (Pryor & Taneja, 2010: 494). Over time, the work of Fayol and Follett seems to have been regarded as of less importance, as their research has been fragmented, simplified, and misinterpreted (Pryor & Taneja, 2010: 494). Parker and Ritson (2005a: 1336, as cited in Pryor & Taneja, 2010: 494) analysed and compared Fayol's and Follett's thoughts to assess: "... the [degree] to which their theories reflected later emerging schools of thinking and practice (as well as) the degree to which subsequent authors and commentators stereotyped their research". The intent of Parker and Ritson (2005a: 1336, as cited in Pryor & Taneja, 2010: 494) was to reveal the "more complex characteristics of their thinking and in the presence of today's management theory and practice" (Pryor & Taneja, 2010: 494). Now, after the age of disgrace, some still prefer not to (re-)reflect on Fayol and Follet. Maybe it is time to do so.

Fayol's management theories were the product of his life experience as a management practitioner, then a theoretician. By contrast, Mintzberg's experience was just a snapshot of the reality of his practice as a scholar and academic (Pryor & Taneja, 2010: 494). According to Lamond (2004: 330, as cited in Pryor & Taneja, 2010: 494), "Fayol has given us management as we would want it to be, and Mintzberg has given us management as it is". However (Wren, 1994, as cited in Pryor & Taneja, 2010: 494), the ideas of Fayol and Mintzberg are distinct, but they do not compete. Both contributed beneficial management theories, and their hypotheses are not mutually exclusive (Pryor & Taneja, 2010: 494). Lamond (2003: 5, as cited in Pryor & Taneja, 2010: 494) "argues that what Mintzberg has done, albeit unwillingly and unwittingly, was to reaffirm and elaborate Fayol's ideation on management".

3.4.1 Comparison between Porter and Fayol

Writing by Fayol has involved critical analysis. He noted, for example, when discussing planning that "managing means looking ahead" (Fayol, 1954: 43, Pryor & Taneja, 2010: 495). Pryor and Taneja (2010: 495) interpreted Fayol's comments as saying that plans are based on:

- The company's resources.
- The essence and importance of work in progress.
- Future trends in technological, commercial, economic and other circumstances that are subject to change.

Fayol identified many of the solutions required in strategic planning. Nevertheless, the ability to use Fayol's insights to justify and support Porter's theories involves more than a comparison with Porter (Pryor & Taneja, 2010: 495). To place it in the right context, Yoo et al. (2006: 354, as cited in Pryor & Taneja, 2010: 495) recommended: "an alternative way of thinking about implementing the Porter paradigm (for strategic management, in particular, cost-leadership and differentiation strategies), i.e. using Fayol's time-honoured management concepts". They proposed using Fayol's theories to implement Porter's theories, increase comprehension and encourage strategy implementation. Yoo et al. (2006: 356, as cited in Pryor & Taneja, 2010: 495) noted that they explicitly discuss the effect of each of the Fayol principles on cost management and differentiation strategies.

3.4.2 Comparison between Taylor and Fayol

Berdayes (2002, 40 as cited in Pryor & Taneja, 2010: 495) discussed Fayol and Taylor's classical theories and postulated that their proposals are manifestations of "panoptic debate," i.e. communication on "practising contemporary social control". Early contributions to classical

management theory that were made by Fayol and Taylor. Berdayes (2002, as cited in Pryor & Taneja, 2010: 495) suggests that the following concepts of Fayol and Taylor unite their work:

- Work processes.
- Organisational structures
- The hierarchical division of labour (Pryor & Taneja, 2010: 495).

It is argued that the development of the organisation as a whole was undertaken owing to work performed by Fayol and Taylor. (Fayol identified specific lines of authority in a philosophical and practical unit, and Taylor highlighted formalisation of work procedures in the entire organisation). It stressed structured reasoning by encouraging scientific techniques, order and effectiveness (Pryor & Taneja, 2010: 495).

Managers collaborate with and encourage their staff. Taylor (1947, as cited in Pryor & Taneja, 2010: 495) suggested that managers work with employees to help, support and smooth their path (Pryor & Taneja, 2010: 495). He also sought to reform their behaviour and actions based on scientific principles. Similarly, Fayol (1949, as cited in Pryor & Taneja, 2010: 495) observed the need to assess employees' skills, inspire and educate them, and reward their passion, initiative and achievement (Pryor & Taneja, 2010: 495).

Although work by Fayol and Taylor provided comparable theories and insights, their theories also differed when compared (Brunsson, 2008 as cited in Pryor & Taneja, 2010: 496). Berdayes (2002, as cited in Pryor & Taneja, 2010: 495) stated that Fayol was more flexible in applying his ideas to maintain flexibility in implementing his theories (Brunsson, 2008, as cited in Pryor & Taneja, 2010: 496). Brunsson (2008, as cited in Pryor & Taneja, 2010: 495) contrasted the theories of Fayol and Taylor further. The author postulated that Taylor's views are typically based on a bottom-up perspective of organisations and that Fayol's views, by comparison, are typically based on a top-down approach. Brunsson (2008: 38, as cited in Pryor & Taneja, 2010: 495) noted that both Fayol and Taylor "considered that all forms of organisations require management and managers, irrespective of volume, scale or location". Taylor's "scientific management" concepts are focused on [...] specialisation and standardisation […] 'Regulating the connection between managers and their subordinates' (Brunsson 2008: 38, as cited in Pryor & Taneja, 2010: 495). Taylor believed that managers and workers would specialise. Still, Brunsson anticipated management practices to differ according to the type of product that is manufactured or the service that is rendered within the market segment in which the organisation is positioned (Brunsson, 2008, as cited in Pryor & Taneja, 2010: 496).

3.5 CURRENT RELEVANCE OF FAYOL'S MODEL

It is clear that reconsidering and using Fayol's observations will add value to the current context. Also known as Fayol's Classic Work (1949), the Fayol model (14 principles for managers and five areas of management activity) applies to contemporary management (Pryor & Taneja, 2010: 497). Hales (1986, as cited in Pryor & Taneja, 2010: 497) also accepted Fayol's theory by using three of Fayol's management roles (planning, controlling and directing) in his model. Hales (1986) observed that Fayol's five areas of management activity, i.e. planning, organising, coordinating, commanding and controlling, have passed time checks and are important to all organisations (Pryor & Taneja, 2010: 497). Mintzberg (1989: 9, as cited in Pryor & Taneja, 2010: 497) technically agreed when he said, "If you ask managers what they're doing, they're more likely to tell you they're planning, organising, and controlling''. However, Mintzberg strongly disagreed that this happened in practice; he indicated that if one peeks at managers at work, one will find that what they are doing, is the opposite (Pryor & Taneja, 2010: 497).

Archer (1990, as cited in Pryor & Taneja, 2010: 497-498) believed that the US would adopt the principles of Fayol again. Archer accepted Fayol's ideals as the US prospered and living conditions improved between 1930 and 1960 (Pryor & Taneja, 2010: 497-498). Archer also argued that much of Japan's success could be attributed to the principles of Fayol. He provided examples of Japanese techniques incorporating the principles of the Fayol model (Archer, 1990: 19-22; Fells, 2000: 345, as cited in Pryor & Taneja, 2010: 497-498):

- Just in time (JIT) relates to Fayol's principle of order.
- Advanced approaches to assembly line balancing, quality, and production control mechanisms relate to the division of work.
- Quality circles increase esprit de corps.
- Lower-level decision-making (empowerment and process ownership) relates to Fayol's principle of the initiative.

These authors agree with Archer (1990) and believe that Fayol's theories are relevant in today's organisations (Pryor & Taneja, 2010: 497-498). In looking at a new appreciation of Fayol by contemporary authors, it seems that his main crucial ideas are gaining academic traction in management studies and that in re-evaluation of Fayol's insights, much can be gained. This does not mean that his insights should be followed blindly. It does mean, however, that his main ideas still hold and with some refinement provide the modern manager with some valuable lessons. In refining Fayol's views without relinquishing some of his central ideas born in practice, one may discover (or perhaps relearn?) some useful lessons on

management and future management, also in the South African context. These could apply to reflections on managing quality water provision at local government level in South Africa.

Management theory and leadership theory are essential in dealing with contemporary management and leadership challenges managers face daily. These theories give a foundation on which to build knowledge gained and expertise obtained. They offer scholars of management and leadership theory the background to understand the world as a set of related systems and that everything is in some way or another interconnected. To this end, as part of this study, it is essential to relate to the following example of a man who achieved countless successes that many men or women could only dream of in a lifetime.

Through some metrics, US General Colin Powell is one of the most prominent and successful 20th century military figures, with numerous 'first' and 'youngest' achieved in his distinguished career. His credibility as a 'leadership guru' is massive, and many of his guiding and managing principles are ideal for managers running civil organisations. As one of Powell's leadership ideals he followed and worked by, the following is cited: "Fit no stereotypes. Do not chase the latest management fads. The situation dictates which approach better fulfils the team's mission" (Prussakov, 2009). While Fayol's management principles are discussed in this chapter, it is clear that for a manager it is essential to define a management and leadership style with which one is happy and to remain faithful to that style, rather than following the current management fads in the expectation that future results will be different or better.

Table 3.1 below is an example of management fads that were embraced and implemented by many a manager over the years.

Table 3.1: Fads and facts decade - Description of fads and facts as adapted from Ketchen Jr. and Short (2011: 18)

Decade	Fad	Description	The Facts
1950s	Management by Objectives	A supervisor and an employee create a series of goals that provide structure and motivation for the employee.	Very many studies show that setting challenging but attainable goals leads to good performance, but not every aspect of work can be captured by a goal.
1960s	Sensitivity Training	Free-flowing group discussions are used to lead individuals toward greater understanding of themselves and others.	Because a ‘mob mentality’ can take over a group, sensitivity training too often degenerates into hostility and humiliation.
1970s	Matrix Structures	Organisational charts are based on cross-functional teams rather than being based on functional areas (e.g.,	Matrix structures are beneficial for firms whose work is based on projects of limited duration (e.g., engineering firms), but such

Decade	Fad	Description	The Facts
		accounting, marketing, finance, human resources).	structures are not well suited for most situations.
1970s	Quality Circles	Volunteer employee groups are developed to brainstorm new methods or processes to improve quality.	Quality is essential, but managers face trade-offs among quality, cost, flexibility, and speed. A singular obsession with quality sacrifices too much along other dimensions.
1980s	Organisational Culture	Fuelled by *In Search of Excellence* (1982) and fascination with Japanese management systems, having an influential culture became viewed as crucial to organisational success.	Within a few years, many of the 'excellent' companies highlighted in the book had fallen on hard times. However, firms such as Disney continue to gain competitive advantage through their active cultures

3.6 CONCLUSION

Besides being able to grasp just how business management evolved to where it is now, there could be even more significant benefits to discover and critically question contemporary leadership theories. This opportunity may also become the vocabulary of a leadership strategy for academia and industry, allowing companies to evolve to the next level of workplace productivity and satisfaction. By emulating certain behaviour in certain settings, although flattering, is not necessarily the best method to employ creativity that propels a society forward, but innovation and creativity definitely are (Dent & Bozeman, 2014: 160).

While traditional management theory now seems outdated, it is essential as a theoretical research subject. As a theory, it developed the concept of management practice and offered a basis for ideas later proposed by schools of management science. The neoclassical approach has overemphasised human factors and abstract incentives that the recipient's 'significant others' could not understand. It is the foundation of other management theories. Therefore, it is evident that there are existing and accurate management theories that are underpinned by realistic research evidence. This development offers a promising future for analysis, research and management practice (Sarker & Khan, 2013: 5).

Much can be learnt from Fayol's theory of management that can be applied in today's knowledge-based society where managers must make informed decisions within a confined period that may have detrimental implications for the organisation or promote a strategy or an idea to the next level, with excellent returns on investment. Despite the simplicity of Fayol's theory, i.e. forecasting, planning, organising, coordinating, commanding and controlling, it has stood the test of time. The splendour of Fayol's management theory is vested in the fact that

its principles of management theory can be taught to and understood/grasped by even the lowest level of employee in any organisation. In our current context, South Africa may gain much in reflecting on Fayol’s insights into combination with insights gained from other theorists and expert practitioners in the field.

The manager is like a conductor who initiates every initiative in such a way that each part of the ensemble creates the best sound for clear symphonic music arising from it. How good the music sounds, depends on the maestro's strength, leadership and management skills. Because management "conducts things successfully by others," management skills are essential to achieving success (Luke, 2011: 104).

In the following chapter, these arguments and their implications are further explored in the South African context.

4

ANALYSIS AND DISCUSSION

In the late 1980s, Egypt's Foreign Minister Boutros Boutros-Ghali warned that the next war in the Middle East would be over water (Campbell & Parthemore, 2016: 3).

4.1 INTRODUCTION

In this chapter, an analysis of data collected in Chapters 2 and 3 is conducted and discussed to give meaning to the data and to bring this discussion into perspective.

According to the Water Governance Facility, the following was stated:

> "Most vulnerable in a world of greater water insecurity are poor people living in informal urban settlements and those in rural areas whose livelihoods are dependent upon rainfed (precipitation) agriculture or the availability of grasslands and water for grazing animals. Protecting the rights of such people and avoiding elite capture of the resource and the benefits derived from it, require tools that foster a more equitable allocation of scarce water resources" (UNESCO, 2015: 20).

By 2030 (WWAP, 2012: 317; NW & SMP, 2018: 1-2), without concerted intervention, South Africa's water shortage could vary from 2.7 to 3.8 billion m^3, based on existing demand projections. This resource serves a population of over 58.78 million people (Stats SA, 2019: v) and the third-largest economy in Africa in a climate that approaches water insecurity (Muller, 2016: 7). According to UN projections, "... 71.3% of the South African population would reside in metropolitan areas by 2030, approaching almost 80% by 2050". With a projected 65 million people by 2050, keeping the promise of a better existence for everyone will be a big challenge for the government. The three metropolitan areas (Gauteng, Western Cape and eThekwini) will face the largest rise in population development owing to natural growth and migration within South Africa, but also from SADC countries and beyond (Staff Writer, 2020b).

Muller (2016: 7) is correct in stating that South Africa is reaching a state of water insecurity. The problem in South Africa is not that there is not enough water, but that there are too many people depending on quality water and not enough resources to sustain the number of people living in South Africa. People are living longer owing to advances in medicine, better health care, nutrition, and access to knowledge via the internet and improved standards of living in general. This is the general trend in the world, accompanied by the incidence of war,

famine, corruption, and poor governance where nations are subjected to hardship and suffering. South Africa has outstripped its natural resource sustainability compared to population growth.

From 2002 to 2019 the life expectancy for males rose from 53.7 to 61.5 and for females from 58 to 67.7 years (Stats SA, 2019b: 5). The population is rising faster than expected. The NPC estimated that by 2030 the population of South Africa would consist of 58.5 million people (NPC, 2011: 77). This milestone was already surpassed by the middle of 2019. South Africa's population was already standing at 58.78 million people by the time Statistics South Africa (Stats SA) released its latest figures in 2019 (Stats SA, 2019b: v). South Africa can no longer continue along the same path as before and drastic measures will have to be implemented to ensure the sustainability of the country's economy and its people. This should be done to contain the existential threat that water insecurity poses to the way people live in South Africa.

The supply of water to deprived communities for economic purposes is not according to current information, effectively planned for sustainable and economic development in South Africa. While more than 40% of South Africans still live in rural areas, only a small percentage of them are engaged in substantial agricultural activity. Urbanisation slowed by apartheid, has advanced steadily after the elimination of barriers to movement and the onset of democracy post 1994 (Muller, 2016: 8).

Studies have shown that there is ample water until 2025 and beyond to satisfy all the country's needs. Present and future challenges are primarily linked to insufficient financial capital and operational capacities, rather than supply restrictions. It is important to take cognisance of the following statement, since this argument drives at the heart of the analysis as South Africa is facing the task of managing local water resources: "Present problems and future challenges are related mainly to limited financial resources and institutional capabilities, rather than to limitations of the resource. Thus, a water crisis may arise if the right investments, innovations and management decisions are not made at the right time" (Muller et al., 2009: 5).

Lack of or the complete absence of water will affect employment and livelihoods, dry taps, and unnecessarily spread diseases (Muller et al., 2009: 5). The point is, therefore, that if adequately grasped and replied to, South Africa's water-related problems need not constrain national growth and development. Efficient water management is therefore necessary if the country is to achieve optimum social and economic development and sustainably (Muller et al., 2009: 6).

In view of national security focusing on the safety of citizen's health and wellbeing, food security is a valuable key ingredient of the growth and development of a nation. Similarly, is the protection of the citizens from violence and crime. It is therefore important to take note of

the following quotation: "*A hungry man is an angry man*" (Anike, 2019: 9). Several academic findings allude to the nexus of food security and national security, although the concept is contentious (this link is touched on later in the chapter).

The situation in which South Africans reside and function must be understood. Water was always scarce in South Africa. Normal annual rainfall is only 495 mm, compared with the world average of 1 033 mm (Muller et al., 2018: 1). The United Nations Economic Commission for Africa (as cited in Muller et al., 2018: 1) predicts that South Africa will have the ninth lowest per capita water supply in Africa by 2025. South Africa has regularly undergone severe droughts over the last century. The Vaal River flow has plummeted below half of its usual flow for three years in a row (Muller et al., 2018: 1). As the population of South Africa increases, and the economy expands, susceptibility to drought will pose a significant problem to the way of life of people and their prosperity as well as economic growth. Cape Town's past has demonstrated how quickly a major city can enter a water crisis unless it is prepared (Muller et al., 2018: 1).

The above sets the background to South Africa's precarious position as a water-scarce country and the state of water resources and infrastructure. Based on the data that was collected, analyses and discussion follow next in more detail.

4.2 THEMATIC FRAMEWORK DISCUSSION

Several themes were identified during the literature review for this study. These themes were grouped into two main themes, namely:

- Human factors threatening water security, which should be managed through continued intervention at local government.
- Planning for the management of unpredictable potential environmental threats.

These themes both relate to human action or inaction that contributes to the management of South Africa's water resources and infrastructure at local government level, which ranges from mismanagement or inadequate management to excellent management in some cases. This thematic framework is based on areas of concern that consistently feature not only in South African literature on water management, but also in international research that has been done on the subject.

Figure 9 on the next page will subsequently be discussed in more detail.

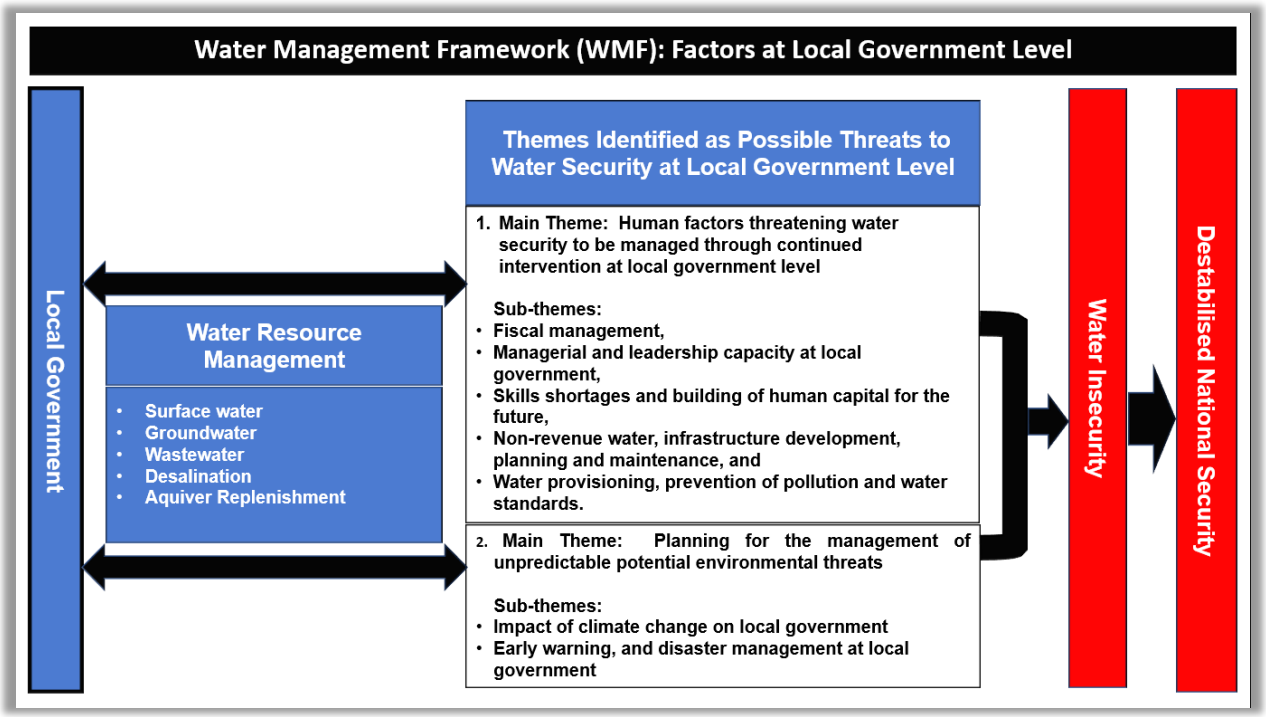


Figure 4.1: Thematic framework developed based on findings in the literature review of the study

Source: Thematic framework developed by the researcher based on literature studied.

In general, local government is responsible for the management of the following water resources:

- Surface water,
- Groundwater,
- Wastewater,
- Desalination where applicable, and
- Aquifer replenishment where applicable.

In the next section, the function of local government is discussed in more detail as well as the problems that do exist in the role of local government to provide potable water to the people of South Africa.

To bring this thematic model developed by the researcher into context, some observations are necessary. The two main themes mentioned above demand the employment of resources to mitigate adverse consequences. Each theme has a number of sub-themes that were identified and are discussed in more detail.

4.2.1 Main theme 1: Human factors threatening water security to be managed through continued intervention at local government level

This main theme refers to the human factor interface at local government level that threatens water security, which should be managed to ensure that potable water is delivered to all the people under its jurisdiction. Sub-themes have been identified describing factors that prohibit or prevent municipalities from providing the following:

- Provide sustained potable water that complies with minimum acceptable standards to the people living within the geographical borders of a municipality.
- Ensure that sanitation services are rendered and that the used water is treated to an acceptable standard before it is released back into streams and rivers or reused for agricultural purposes.
- Ensure that maintenance of existing infrastructure or any new infrastructure is carried out in time, within the allocated budget.
- Take responsibility for revenue collection from the users of water that was provided, as this money must be used to pay the water boards for the supply of water to the municipalities. Revenue collected can also be employed as capital towards new or existing infrastructure maintenance and/or development, labour cost and materials.

The following sub-themes were identified:

- Fiscal management,
- Managerial and leadership capacity at local government,
- Skills shortages and building of human capital for the future,
- Non-revenue water, infrastructure development, planning and maintenance, and
- Water provisioning, prevention of pollution and water standards.

4.2.1 1 Sub-theme: Fiscal management

The power infrastructure development backlog is compounded by the financial crisis in which the DWS finds itself. The DHSW&S budget is limited and continues to diminish, as stated by the Minister of Human Settlements, Water and Sanitation, Minister L.N. Sisulu. The minister said the government anticipates a R333-billion budget deficit in the next ten years. In addition, the Department has a R59-billion backlog in terms of refurbishment of infrastructure (Mthethwa, 2019).

South Africa’s debt-to-GDP ratio was estimated at 59.7% in the February 2019 budget (Brand, 2019) and revenue collection shortfalls for the FY 2019/20 amount to R63.3 billion (Donnelly, 2019; Visser, 2020) in the current fiscus. In response to these realities and other

requirements such as the building of schools, hospitals, job creation initiatives[11], the fees must fall[12] initiative and social grants[13], Treasury has indicated that revenue shortfalls (pre COVID-19) are expected to total R251 billion in the coming three years (Donnelly, 2019). On top of that, SARS reported that the South African economy had entered into a technical recession, as the seasonally adjusted annual GDP contracted by 1.4% quarter on quarter in the fourth quarter of 2019, down from a contraction of 0.8% in the third quarter of 2019 (South Africa, 2020). By June 2020, Treasury announced that the economy was expected to contract 7.2% based on the latest data that was available (Ngalonkulu, 2020).

Most water institutions face significant financial difficulties relating to both bulk water supplies and the delivery of municipal water services. The most visible problems are at national and local rather than at provincial level (Muller et al., 2018: 26).

National Treasury and the AG reported to Parliament on severe problems encountered by the DHSW&S and its Water Trading Entity in recent years. According to the AG, the liabilities of DHSW&S exceeded its assets by around R500 million in 2017/18, compromising its capacity to operate as a concern. According to National Treasury, the DHSW&S had begun the year with an overdraft of over R2.6 billion, which was reduced to R1.9 billion by year-end. While most of the DHSW&S debt in 2017/18 related to payments due from municipalities to DHSW&S (including Emfuleni), the DHSW&S appears to have spent funds without sufficient debt recovery initiatives. It would appear as if most of the debt will have to be written off (Muller et al., 2018: 26).

The total amount owed for bulk water by municipalities in December 2017 was R7.3 billion; this was owed primarily to water boards. There is still substantial 'cross-debt', with water boards unable to pay their entire R11 billion debt to the DHSW&S (Muller et al., 2018: 27). Since 2017, urban water-use debt to the Water Trading Entity and water boards has risen by 14% from R13.1 billion in September 2018 to R14.9 billion in September 2019 (DHSW&S, 2019a). A DWA briefing to the Water and Sanitation Portfolio Committee revealed that the Department's problems included a history of non-payment within municipalities (DHSW&S, 2019b). The simple fact is that municipalities declined to pay, and the debt rose exponentially every year (DHSW&S, 2019b).

[11] Labour force engagement rates in South Africa rose by 0.1% to 29.1% and 59.9%, respectively, compared with the second quarter of 2019 (Stats SA, 2019a: 1).
[12] Tertiary education expenses will more than double by 2022, or 2.5% of GDP, to R172.2 billion ($12 billion). Former President Jacob Zuma declared in December 2017 that tuition fees for students from homes with a gross annual income of R350 000 or less would be scrapped (Bloomberg, 2019).
[13] In the current fiscal year, the government allocated R175 billion in social grants to 17.6 million people. Against this, there are 7.6 million individual taxpayers from whom R553 billion is collected in taxes (Greenblo, 2019).

By comparison, the government gave financial assistance to SOEs such as South African Airways and Eskom that required significant financial support to stay afloat. The researcher is of the opinion that water infrastructure development is not high on the developmental agenda at present and it is deduced that water infrastructure development will be taking a back seat for the immediate future.

The role of the South African National Defence Force (SANDF) in cleaning up the ongoing sewage spillage in the Vaal River system is one case in point. The Deputy President told the press that "more urgent work [is] needed to contain pollution in the Vaal River system". Such interventions include updating ageing sewage and reticulation systems; R1.1 billion is needed to stop Vaal River pollution. In November 2019, the Deputy President announced that the national DHSW&S, together with the Gauteng CoGTA, the Municipal Infrastructure Support Agency, SANDF, Ekurhuleni Water Care Company[14], Emfuleni local municipality and Rand Water had compiled an action strategy to avoid contamination in the Vaal River. The scheme involved fixing 44 pump stations and three wastewater treatment plants (defenceWeb/SAnews, 2019). Since the SANDF could only do so much with its limited budget since the beginning of 2019, it should be noted that in October 2018, President C.R. Ramaphosa declared the sewage problem in the Vaal River system a national crisis and authorised the deployment of the SANDF to intervene. This was done because the local municipality failed to prevent the spill of raw sewage. In June 2019 the SANDF discontinued its refurbishment and maintenance work because it required R1.1 billion to complete the project (Monteiro, 2019).

Research indicated that the sewage spillage issue in the IVRS had been reported to numerous role players at a meeting where the Department of Water, Sanitation and Forestry (DWS&F) was present, as early as November 2007. At the time, the Save the Vaal Environment, an environmental non-governmental organisation (NGO), tried to focus the attention of the government on the fact that "government departments are ineffective" in solving this problem (Marrian, 2007). At this meeting, letters were presented, ranging over a ten-year period, in which the problem of Vaal River pollution was reported to the government with no positive action or outcome. It was said at the meeting in 2007 that Rand Water's engineer at the time, Mr Keith Reynolds, estimated it would cost R650 million to solve the problem. This amount had escalated to R1.1 billion by 2019 (Marrian, 2007). The Vaal River contamination issue that was identified as far back as 2007 had not yet been resolved by the

[14] The East Rand Water Care Company, a professional urban wastewater treatment organisation, at present operates 19 plants in Gauteng serving three municipalities. Rand Water is also partnering with Sedibeng district municipality to help expand the Sebokeng Wastewater Treatment Plant (Muller et al., 2018: 43).

end of 2019. The deduction is made that solving the R333 billion funding gap by the DHSW&S or by the State over the next ten years is highly doubtful too.

4.2.1.2 Sub-theme: Managerial and leadership capacity at local government

According to Makwetu (2019b: 21), the AG SA identified lack of leadership as the root cause of troubled municipalities, including municipal managers and their senior managers who are responsible for the management and service delivery of the municipality, as well as the elected leadership (mayor and representatives of the council) who supervise the running of the municipality and take important decisions. It must be remembered that all members of the provincial leadership (premier, members of the executive council, and heads of provincial departments assisting local government) were held complicit in the AG SA finding (NW&SMP, 2018a: 3-20; Makwetu, 2019b: 21). The Minister agrees with the AG SA that failure by office-bearers, senior managers and officials to create, enforce and oversee successful internal control mechanisms and procedures, including disciplinary measures, contributes to the decline in the manner in which municipalities are run (CoGTA, 2019).

As part of its legislative work, the provincial legislature has a leadership role to play. Makwetu is adamant that the present state of government in municipalities could be turned around if leadership at all three of these tiers were to concentrate on the following critical issues:

- Tone at the top – ethical leadership, good governance, and accountability.
- Capacitate and stabilise administration – free from political interference.
- Enable and insist on robust financial and performance management systems.
- Impose consistent, appropriate and swift consequences for irregularities (Makwetu, 2019b: 21).

This negative trend in local and provincial government concerns problems ranging from weak governance and a low standard of financial statements to inadequate internal controls and performance challenges (CoGTA, 2019).

The AG SA listed the reasons why only 18 municipalities out of 257 received clean audits during the 20017/18 FY. Of the 257 municipalities, 159 (62%) were declared dysfunctional and unable to deliver services as mandated by the Constitution of South Africa (Makwetu, 2019b: 10; Njobeni, 2019).

The findings in the AG Report (Makwetu, 2019b: 10-11) drive at the heart of the dysfunctionality of municipalities, with the following results:

- Accountability failures and audit results are deteriorating. Leadership, senior management and officials failed to develop, enforce, and track successful internal control mechanisms, including corrective action.
- Vacancies and uncertainty in key positions hindered systemic and coordinated reforms, undermining councils' capacity to hold people responsible.
- Lack of adequate financial management skills led to the over-reliance of key officials on contractors and had a negative impact on financial planning, record-keeping and reporting.
- Assessment and control mechanisms were insufficient or incomplete and officials were not held responsible for poor performance.
- Officials lacked the expertise, competencies, or adequate knowledge of performance management monitoring and reporting standards.
- Leadership and municipal officials intentionally or negligently ignored their duties and disobeyed regulations to act against transgressors through proper consequence management techniques and mechanisms at their disposal (Makwetu, 2019b, 10–11).

Makwetu specifically stated that local government's latest governance relapses could only be turned around if the leadership took the lead in moving towards clean public administration (Makwetu, 2019b: 20).

> The leadership sets the tone at the top of any organisation. If an organisation’s leaders are unethical; have a disregard for governance, compliance, and control; and are not committed to transparency and accountability, it will filter through to the lower levels of the organisation. Inevitably, a culture of poor discipline, impunity and non-delivery will develop, leading to the collapse of the organisation (Makwetu, 2019b: 20).

This situation begs the question: Is the human factor interface referred to above merely lacking in capacity at the municipal level and water resources are therefore managed poorly, or are there other factors outside the planning process that interfere with the commitment of budgets for approved short-, medium- and long-term plans pertaining to development and maintenance of water infrastructure, or are these plans in constant flux? The researcher is of the opinion that investing in the development and maintenance of water infrastructure is like investing in an insurance policy. Its value is not immediately evident. When disaster strikes, the true value is appreciated. It is just possible that investment in water infrastructure and maintenance is so costly and not visible to all that local governments defer such projects and use the funds for other projects instead so that the citizens can see that the local government is attending to the needs of communities. Adherence to plans and practising good governance is a management and leadership matter. The inverse is also a management and leadership matter.

4.2.1.3 Sub-theme: Skills shortages and building human capital for the future

It has been widely reported in the literature studied that there are severe skills shortage and skills development needs in the water industry. The answer is logical. Train more people to meet South Africa's developmental needs.

An increasing trend has been reported by the AG SA (Makwetu, 2019b: 3) that more South African municipalities are failing in their mandate to the people and that this failure is the result of not implementing his office's recommendations. Drawing on the literature (Cilliers, Schünemann & Moyer, 2015: 8; South Africa, 2017: 8,13,16; NW & SMP, 2018: 5-14, 6-3, 7-8, 11-1, 11-3, 17-3; Makwetu, 2019b: 10), it is evident that there is a severe shortage of skills in the water management industry. It is further stated that there is a direct link between the poor and deteriorated state of water management of infrastructure, inadequate foresight and planning, and shortages of skilled personnel such as engineers in the water industry. It is stated that this key resource to the South African economy has been neglected and has been polluted to the point where the opinion is expressed that given the impact of climate change, a tipping point[15] has already been reached in terms of water management in South Africa. In view of this and given the downturn in the economy and South Africa's debt-to-GDP ratio of 71.3% that is predicted by 2023 (Brand, 2019; Van Zyl, 2019), the opinion is expressed that South Africa as a nation runs the risk that it will never be able to get ahead or recover to the point where it can safely be stated again that South Africa has surplus water available. Water infrastructure development is extremely expensive and takes many years to plan, budget for and complete.

In the opinion of the researcher, because of the COVID-19 pandemic, the aftermath of the lockdown and the damage it did to the economy, South Africa will reach a 70% debt-to-GDP ratio sooner than the predicted date of 2023. In his opinion, South Africa will reach a 70% debt-to-GDP ratio towards the end of 2021. This statement is based on the latest assessment done by Deloitte, which predicted that South Africa's national debt would reach R3.56 trillion, amounting to a 65.6% share of GDP, by the end of FY 2020/21 (Deloitte, 2020). This assessment by Deloitte was done pre-COVID-19. As costs are rising to deal with COVID-19, this situation will undoubtedly affect South Africa's debt-to-GDP ratio negatively. There is no way of substantiating this, as all existing models the government is using (at the time of writing this study) to make predictions are used in uncharted territory owing to the influence of the pandemic on the world economy (South Africa SCOPA Presentation, 2020: 30). By the

[15] T*ipping point definition: T*he critical point in a situation, process, or system beyond which a significant and often unstoppable effect or change takes place (The Merriam-Webster.com Dictionary, 2019)

first quarter of 2020, the world was still in a downturn. At the end of March 2020, South Africa's sovereign credit status was downgraded, increasing government borrowing expenditure. Estimates by the International Monetary Fund (IMF), the Reserve Bank and the Organisation for Economic Cooperation and Development indicate that economic growth in South Africa will contract between 6-7% in 2020 (South Africa SCOPA Presentation, 2020: 35). By June 2020, Treasury confirmed this prediction by announcing that the economy was expected to contract 7.2% based on the latest data that was available (Ngalonkulu, 2020). This does not bode well for South Africa. Funding for the maintenance of existing and new water infrastructure projects could become problematic post COVID-19.

One major problem for the water sector is the lack of technical capacity. Reliance on skilled consultants to carry out even regular activities in water sector organisations has increased in response (Muller et al., 2018: 31). This has a systemic effect on the growth of human capital and the capacity needed to carry out the dynamic activities of water management. Historically, the public sector had become the largest source of bursary grants and post-graduate employment, but this is no longer the case. As a result, recently qualified students find it difficult to gain the experience necessary to receive professional qualifications, and many of them are lost to the water sector because of this perceived inaction (Muller et al., 2018: 31; NW&SMP, 2018a: 11-6).

To illustrate what Muller et al. (2018: 31) suggested, the DHSW&S states that challenges at all levels contribute to the paralysis it is facing in the implementation of its mandate. It is believed that the following challenges described in the NW&SMP (2018a: 11-6) are not unique to the DHSW&S, but probably exist in all local government structures throughout South Africa:

- “Experienced professionals are leaving public institutions to work in the private sector and in foreign countries due partly to the inability of public sector institutions to attract and retain such staff.
- Mentoring of new entrants into the water sector has become a major challenge due to the shortage of experienced personnel in the public sector.
- Impact assessments are hardly ever conducted, allowing little evidence of the actual impact of capacity building and skills development interventions in the sector.
- Primary planning data, which, under the ideal circumstance, should be generated through the workplace skills planning process, is inadequate.
- Limited water and sanitation sector occupations are listed in the Organising Framework for Occupation (OFO), as these workplace skills plans from employers are not standardised and reflective of the actual needs/gaps. This contributes to the wrong prioritisation and allocation of funding for interventions.

- The ongoing retirement of a large cohort of older, experienced workers is leaving significant gaps in skills and experience in the sector.
- There are new capability requirements to meet the emerging demands of climate change, environmental management, new technologies, and the multi-disciplinary nature of sustainable water management.
- Resource constraints and the low capacity to engage with the water sector hampers the updating of materials, and the generation of new courses relevant to emerging needs and to deliver industry-relevant education and training.
- There are low levels of entrants and completions in education and training programmes pertinent to the water sector, including sciences and engineering" (NW&SMP, 2018a;11-6).

It is evident that the skills shortage the DHSW&S is experiencing is not only deep-rooted and endemic in South Africa. It indicates a far deeper problem that South Africa is facing. The educational system does not prepare and equip school leavers to enter the labour market or prepare them sufficiently to obtain good quality tertiary education so that the public sector, like the DHSW&S, can offer them employment opportunities. To illustrate, it has been found that after five years of schooling, about 50% of South African pupils cannot do basic calculations, such as dividing 24 by three (Ngozo, 2018). It is clear that the education system not only fails the majority of South African pupils but also weakens the labour force; it hampers the market's absorption of those with fewer skills and limits their contribution to economic growth (Ngozo, 2018).

South Africa's educational system was addressed, as this is the foundation of and a building block for future development. Without appropriate education and training, water resource management at all three tiers of government will remain problematic, with no real purpose and drive coupled to tangible outcomes that could solve South Africa's looming water crisis. With the impact of climate change looming, the country does not have the luxury of time on its side to address the deep-seated problem of poor education (NPC, 2013: 14-18; Stats SA, 2017: 3).

4.2.1.4 Sub-theme: Non-revenue water, infrastructure development, planning and maintenance

It was reported that during the 2015/16 FY, where municipalities did not take measures to repair pipes or take action to avoid water leakages as soon as these were identified, water losses of 1 414.49 million m^3 per annum were indicated. The total for non-revenue water (NRW) was reported to be as much as 1 632.93 million m^3 per annum (Annual Report DWS FY 17/18, 2018: 36). NRW means the loss of potable water that has been purified for

distribution to households or businesses for which the municipalities should have billed consumers. Water loss rates, calculated as NRW (unpaid and unmetered water provided to consumers plus leakage from the supply system), vary across provinces from relatively acceptable in Johannesburg (25%), Tshwane (27.7%) and Ekurhuleni (36.6%) to very high in smaller municipalities such as Emfuleni (48.8%). Muller et al. (2018: 27) noted that other estimates are possible, but these should be viewed with caution because there is significant variability in the description of sources and updates. This is compounded by the decision of the previous Minister for Water and Sanitation to stop NRW surveillance and monitoring, rendering it impossible to draw clear conclusions about the situation (Muller et al., 2018: 27). It is not unexpected then, that 39% of the municipalities that disclosed their water losses in the 2018/19 FY reported losses of more than 30%, resulting in an overall loss of R2,6 billion (Makwetu, 2019b: 4).

The above is a typical example of decisions, taken by high-ranking officials who have been appointed to manage the water resources of South Africa for the people of South Africa, that had disastrous consequences.

According to Stats SA (2017), in the *General Household Survey 2016*, in addition to NRW, there are many instances where water is consumed and billed for, but not paid for by consumers. Some 58.5% of households in South Africa reported not paying for water in 2016 (Muller et al., 2018: 28). Instead of 'NRW', such non-payments should be reported as 'municipal debt.' National Treasury estimates that R17.1 billion (the largest urban debt in the country) was owed to the City of Johannesburg in 2017, R13.3 billion to the City of Ekurhuleni and R9.5 billion to the City of Tshwane; Tshwane and Ekurhuleni reported the highest increase in outstanding debtors, at 24.6% and 14.4% respectively. By contrast, the National Treasury reported that the cost of the amount of water physically lost in the system in 2017 was calculated at R1 556 million (Muller et al., 2018: 28).

Insufficient funding and increasing debt limit the capacity of all local government structures to raise funds required to sustain and improve infrastructure for the provision of bulk water. It is necessary to maintain rates as low as possible by increasing efficiency, critically evaluating new infrastructure initiatives, service standards and relevant tariff policies to ensure medium- to long-term viability of service delivery to the people (Muller et al., 2018: 29). Municipalities should collect as much revenue as possible from the supply of water to pay the water boards and other service providers and use the revenue raised in this manner to pay for new projects and for the upkeep of existing infrastructure. If revenue is lost in the system through poor management and monitoring practices, the people will suffer.

An example of this is that some municipalities like Harrismith (Reporter, 2019) and Mangaung (Pijoos, 2019) have been placed under administration owing to poor governance and the total implosion of these municipalities due to maladministration. These municipalities are bankrupt. Makwetu stated (2019b: 8) that five provinces responded to the impending financial crisis through provincial intervention by placing a total of 18 municipalities under administration. This number has increased, as the CoGTA annual report for the 2018/19 FY reports that 39 municipalities in total have been put under administration, most of them either because of inability or unwillingness to fulfil their functions and fiducial responsibilities (Department CoGTA, 2019: 6).

Where water supply is not properly monitored, water usage is not correctly metered and networks are not well documented and managed. Determining in such a context how much water is wasted is challenging. If maintenance workers are not qualified and equipped adequately, even if customer service centres are managed successfully, little progress can be achieved. Action by individual municipalities to reduce water losses should be tracked and reported, something which the DWS has become increasingly reluctant to do in recent years, partly because of the information's political sensitivity (Muller et al., 2018: 29).

Lessons learnt from the initiatives over the past decade are centred on the fact that while reducing leakage is a distinct and essential objective of water resource management, progress depends on effective municipal administration, and a concentrated and financed programme is required to achieve results. Muller et al. (2018: 30) were right to conclude that for municipalities to prosper, minimising the 'NRW' portion, which is consumed but not metered and billed, requires adequate administrative capacity. It is important for the municipality to enforce payment from consumers who are not entitled to a free minimum water allowance or who surpass their free limit. Efficient interventions, therefore, include political decisions and emphasis on improving the performance of municipalities (Muller et al., 2018: 30).

South Africa is lacking in the monitoring and evaluation (M&E) component of effective municipal administration and the poor results on ground level are evidence of this.

Makwetu (2019b: 9) found that poor water supply at local government level can be attributed to several deficiencies in municipal infrastructure development and maintenance. These deficiencies involve underspending of grants, project execution delays and inability to comply with supply chain management regulations (Makwetu, 2019b: 9). Makwetu cited "the lack of attention paid to water and sanitation infrastructures" as a critical concern. It is reported that 32% of the municipalities responsible for water and sanitation did not assess the condition of water and sanitation infrastructure and nearly half did not have maintenance policies in place" (Makwetu, 2019b: 9).

Muller et al. (2018: 23) recommended, in addition to improved plant maintenance, greater preparation and cooperation between provincial housing departments and municipal water departments in respect of new settlements to ensure adequate bulk water. They also recommended advance planning and provision for wastewater treatment and conveying capability in the fiscus.There is general consensus on this recommendation, yet the issue is where to find this additional water for new settlements if the entire current supply has been allocated. Because of poor rainfall and water infrastructure management, no surplus water is available in certain geographical regions in South Africa. To illustrate the predicament with regard to future developments and housing projects in Gauteng, Muller et al. (2018: 18) suggested that in the absence of alternative sources, the pace at which usage is decreased will rise if Rand Water's abstractions are retained at its licence limits.

4.2.1.5 Sub-theme: Water provisioning, prevention of pollution and water standards

Numerous reports and newspaper articles perused as part of the study indicate failure or apparent inability to arrest the current pollution problem that has become such an everyday occurrence in rivers and streams around South Africa. This trend begs the question why this takes place on such a large scale and why local government does very little to discourage it from occurring in the first place and, secondly, allows it to escalate (WWF-SA, 2016: 51).

Towns and cities are failing to process the growing domestic and industrial effluent that is being generated. Water treatment systems are struggling to cope with the volume of wastewater. Pollution from irrigated crop return flows (pesticides and fertilisers) and acid mine drainage is a big issue, exacerbated by decreased dilution capacity and decline of the irrigation network from stable riparian areas (CSIR, 2010: 26). The economic impact of contaminated surface water supplies includes the expense of wastewater treatment, loss of agricultural production, loss of water storage capability, loss of human health and quality of life caused by waterborne diseases, as well as failure of ecological services (Roux, Oelofse & Lange, 2010: 2).

Ensuring sufficient water availability is often prioritised because water security also depends on preserving and protecting the environment and to ensure that water quality is fit for consumption. Wastewater management is as important a part of the water cycle as other processes. Municipal wastewater is treated and returned to rivers. These are known as backflows and are essential for downstream consumers. Gauteng's water quality is essential to all downstream consumers (municipal, agricultural, and industrial). Resource water quality objectives have been developed to reduce pollutant concentration. In the past it was always necessary to release wastewater from the Vaal Dam to dilute contaminants to acceptable

levels. This is unnecessary use of scarce (and thus valuable) resources, which can best be handled by reducing untreated wastewater emissions from wastewater treatment plants and other sources (Muller et al., 2018: 13).

The Water and Sanitation Department monitored the situation through the Green Drop Assessment Report. The report focused on the management and maintaining wastewater treatment works and related sewage infrastructure. There have been no Green Drop Reports since 2014. These reports proved helpful and the lapse in releasing them is unfortunate for water-management in the current context. Compliance with the 2014 Green Drop criteria was largely dismal, with 119 of 144 Water Service Authorities showing compliance below 80%. These reports are no longer made public. According to the WWF-SA (2016: 76), resource water quality degradation was found to be mainly the product of damaged sewage collectors and pump sets, as well as defective wastewater treatment works. Wastewater services are provided by 152 WSAUs across a network of 824 wastewater collection and treatment facilities in South Africa. The total operating flow of 5 128.8 Ml/day is received at 824 treatment facilities with a total hydraulic design capability of 6 509.7 Ml/day (WWF-SA, 2016: 76). It means that 78% of total production capacity is already accounted for, leaving a potential surplus of 22% as the capacity required for future demand, while many plants have a small surplus and operate at maximum capacity.

Muller et al. (2018: 23) stated that according to municipal surveys, certain treatment plants, particularly in smaller communities, are not adequately staffed and operated. In addition, some treatment works are overwhelmed by both the increase in served settlements, but also stormwater access through sewage networks. This often occurs through natural stormwater flow through sewers, but also when stormwater runoff is deliberately connected to sewers. In certain instances, unscrupulous developers do so deliberately to reduce their development costs. This water supply and sanitation crisis poses a serious threat to South Africans' health and well-being, while adversely affecting economic development and environmental sustainability (NW & SMP, 2018: 1-2).

The predicted shortage in water supply by 2030 could be compared to what the NW&SMP (2018: 1-2) expects, as the WWF-SA made a similar prediction in 2016. In 2015, a population of approximately 42 million (population average at the time of calculation) was estimated to have just over 1 200 kilolitres of fresh water per person per year, much of which was already reserved. Since then, with population growth, water supply per person has become theoretically less. South Africa's demand was projected to be 17.7 trillion m^3 in 2016, which exceeds the available reserve as it stands. Assessments also indicated in 2016 that South Africa's water availability was 843 m^3 per person per year, while that of arid countries

such as Namibia and Botswana was 2 674 m^3 and 1 187m^3 respectively (Water Shortage South Africa and OUTA, 2019: 5).

Under current conditions, South Africans are forced to look at water management and water conservation in different ways to run households, prevent diseases from spreading, practise agriculture and grow the economy. Keeping projections for the future in mind South Africans will need to be creative in the way water is used and reused for domestic, industrial, agricultural and energy generation purposes. The alternative (doing nothing and continuing mismanagement as in the case of the Vaal River sewage spillage) is no longer an option. The effect of population growth on natural resources remains a topic of concern. For example, Gauteng's population is growing at over 3% per year, implying that water will have to be provided to over 400 000 additional residents a year or that a new water supply system will be required for a city the size of Soweto every five years (Muller et al., 2018: 18).

It is evident that water is key to prosperity, peace, good health and stability in South Africa and holds a pivotal position to unlocking wealth in all spheres of South African life. It is enshrined as a fundamental right in the Constitution of South Africa. The irony is that this fundamental right is being neglected to the point where vast sums of money (Mthethwa, 2019) will have to be spent to recover and use what is left of this resource, as future population growth and economic development will outstrip water supply. The effects of climate change will amplify deficiencies and shortcomings in the water supply chain. The risk is that when the taps run dry, the time to recover from an insecure water position to a water-secure position in the country will be difficult if not near impossible, especially in conjunction with the added effects of climate change. The consequences of such a situation will be catastrophic.

In terms of stable water supply, the country cannot continue to consider any large scale urban development or human settlement projects without causing waterborne disease break-outs, because there is inadequate water supply to satisfy demand. Turning around the foreseeable ecological crisis would entail national trade-offs between noxious and polluting commercial development and health and ecosystem integrity. Water management demands control and user behaviour reforms and compliance protocols resulting from this need to be introduced, controlled and enforced at municipal level (NSDF Draft, 2019: 54). The survival of all South Africans will depend on future management strategies that are successfully applied.

4.2.2 Main theme 2: Planning for the management of unpredictable potential environmental threats

4.2.2.1 Sub-theme: Impact of climate change on local government

The first sub-theme under environmental threats is the impact of climate change and planning for extreme events by local governments.

President Ramaphosa has an extraordinary chance to become a world leader by adapting to one of the biggest challenges to civilisation as it is known (Le Page, Davies & Hamilton, 2019). He has recognised climate change threats and adverse impacts. At the 2018 World Economic Forum Annual Meeting in Davos, Ramaphosa said that climate change is "not just a fable or a myth", and the drought in Cape Town was an example of the "true impact of climate change" (Le Page, Davies & Hamilton, 2019).

Municipalities and municipal managers, in particular, should ask themselves when, where and how much the climate will change, and how this will affect residents. Will it be steady, rapid, or volatile climate change? Who should do something about it, what should be done, and where? (Van Niekerk et al., 2009: 23). Like many other developing countries, South Africa is highly vulnerable to the impact of climate change (Kreft, Eckstein & Melchior, 2017, as cited in DEA, 2017: 7). It is facing the challenge of balancing the development of economic growth and transition with sustainable use of environmental resources and responding to climate change (DEA, 2017: 7). Climate change and water insecurity are inextricably linked. Local governments will be increasingly affected as droughts become more regular and last for more extended periods.

In a survey titled *Poverty Patterns in South Africa* by Stats SA, an analysis of severe poverty between 2006 and 2015 was conducted. In this survey it was stated that more than half of the South African population lived below the poverty line, confronting the threat of climate change, high temperatures and the potential effects these may have on human health (Gambade, 2019).

Included in their planning, local governments will need to address the challenges of climate change and food insecurity, and the consequences of natural disasters such as droughts and floods. South Africa should prepare and execute these plans down to local government and community levels. Displacement of populaces can lead to significant socio-economic instability, negative health effects and heightened death and suffering. Migrant movements would create housing, employment, infrastructure and other problems for municipalities unexpectedly having to deal with vast numbers of climate change refugees,

resulting in rising poverty and crime concentrations in the most vulnerable parts of cities (Van Niekerk et al., 2009: 19; Welborn, 2018: 13).

Efforts to adjust and reduce problems may have minimal success when applied in discord. When adaptation and mitigation efforts are applied in unison, the results are much more efficient. No one approach is ideal for human and environmental settings. Instead, the IPCC emphasised that local solutions to climate change ought to be proactive and concentrate on creating resilience at community level (Welborn, 2018:8). Since climate change will eventually escalate by at least mid-century, responding to it will require the involvement of local government in the early stages of preparation and planning. According to Wellborn (2018:8), it is crucial to determine the interlinkages between adaptation and development as early as possible to give a better chance at survival. In Agenda 2063, African leaders expressed the aspiration that “Africa shall address the global challenge of climate change by prioritising adaptation in all our actions [...] for the survival of the most vulnerable populations [...] and for sustainable development and shared prosperity” (Welborn, 2018: 8).

Another dimension that should be addressed by local governments is the population growth rate. Climate change will have an impact on population growth. Large, fast-growing populations in Africa, for example, put a tremendous burden on environmental systems and exacerbate the detrimental effects of climate change. Likewise, IPCC studies have found that overpopulation is a significant stressor affecting water quality and availability in Africa, and has done more damage to the availability of water in certain areas than climate change (Welborn, 2018: 17).

Based on Welborn's argument, it is foreseen that population growth will have a devastating effect on the availability and sustainability of resources in South Africa. If the South African economy continues to grow at the current pace, the population will increase from 58.56 million to 65-67 million by 2030. If the economy contracts as it is doing at present, the current fertility rate is likely to remain the same, with the population reaching 75 million – 78 million by 2055 before cooling down (World Population Review, 2019). For planning purposes, at local government level, these figures become critical for future development and resource planning for the whole of South Africa.

When planning for the future, Welborn (2018: 17) stated that, provided that climate change effects are foreseen to escalate eventually until at least mid-century, for municipalities to strengthen disaster risk management, the safest strategy would be to avert more needless loss of life in droughts, floods and other natural disasters. From a current post-disaster reactive posture, a more constructive approach would be more beneficial in planning for the effects of climate change at local government level.

While drought ravaged the Eastern Cape, Northern Cape and Limpopo (2019), Agri SA indicated in a report released on the drought situation in South Africa 2018/2019, that urgent discussions would be scheduled with CoGTA, the DWS and the National Disaster Management Centre to discuss the looming water crisis in specific areas due to lack of forward planning and general maintenance of water infrastructure (Agri SA COE, 2019: 1). South Africa's agricultural sector acknowledges that the government is by no means effective in tackling disasters like the 2018 and 2019 drought that crippled the agricultural industry in the country (Agri SA COE, 2019: 1).

At the moment, the economy is functioning with a national GDP of R4,65 trillion (Stats SA, 2019a: 76). It is argued that an extended drought has the potential to cripple the economy. When this happens, there will be no surplus money in the fiscus to assist with drought relief and emergency water supply to communities. If no provision is made when the economy is strong, it is very unlikely that money would be found when the worst happens. Therefore, these initiatives must be taken now to secure the country’s future by implementing drastic changes. It is further argued that vast sums of money spent now on water security is an investment in the future, which in any terms will be costly. The point is made that it will be costly now, but that not spending the funds could lead to a worse situation. Possible consequences could be famine, war, intrastate wars, a destabilised region with little if any economic trade and mass migrations. The picture that the scientific community is painting is that of an apocalyptic outcome in which climate migrants will be moving from one geographical region to the next. This is to be avoided at all costs.

4.2.2.2 Sub-theme: Early warning and disaster management at local government

The second sub-theme under climate change refers to early warning and disaster management at local government level.

In accordance with the framework that was developed, the fallout of water insecurity and food insecurity and how well this is mitigated can again be traced back to the management of the risks and the detail and efficacy of plans that were developed to deal with these occurrences well in advance before they become a problem. One cannot forecast with sufficient precision when future flooding and droughts will occur and how extreme they will be, but improved infrastructure planning and better government coordination can protect people in the short run (Le Page, Davies & Hamilton, 2019).

Early warning systems should be (put in) in place, warning the local government that a crisis is looming in the case of water scarcity during droughts. Should the local government not have the capacity to deal with the problem, the problem should be escalated to the national government for assistance in the form of drought relief. It would appear that at present the

governmental disaster relief mechanisms are only focusing on post-impact relief, rather than prior-impact preparation (Butler, 2019).

Drought is a socio-natural problem, and management needs intervention in numerous fields – public, political-institutional, regulatory, technical and scientific. Drought management requires unique skills and expertise in implementing innovative solutions and interconnected water catchment management agencies. Drought management may include resource management, demand management, dispute management and monitoring of drought, including an early warning capability (Muller et al., 2018: 34).

In theory, when looking at spatial design of towns and cities, consideration is given to the availability and provisioning of services, e.g. water provisioning, wastewater management, electricity and stormwater drainage. Lack of versatility in the building, maintenance and upgrading of bulk water, energy and transport infrastructure at the municipal level will require dedicated investment from the national and provincial departments responsible for municipal and spatial planning to help create and sustain stable and efficient urban developments (NSDF Draft, 2019: 122).

During urban planning, consideration should be given to how to plan and build the infrastructure for coping with natural phenomena such as floods and droughts. This applies to stormwater drainage, water run-off from road surfaces, streetlights and safe electricity supply, to name a few examples. Similarly, stormwater drainage systems should be built in advance and maintained in case a flood does occur; water will then disperse with minimal damage to property and infrastructure. In many instances, this maintenance is not done (Nxumalo, 2016). Plastic pollution, the modern-day scourge, is a leading cause of stormwater drainage failure and requires maintenance to be carried out at regular intervals (EPA, Australia, 2011; Dawood, 2019; Staff Reporter, 2019; Staff Writer, 2019b).

There is a legacy issue going back to the apartheid system when not much thought was given to the spatial design and the supply of services to townships on the outskirts of towns and cities (Molobela & Sinha, 2011: 995). The aftermath of that legacy is still evident today and will be for years to come. This lack of infrastructure development 26 years after the advent of democracy has become a problem in many cases at local government, as the infrastructure cannot cope with the demand as settlements grow in size and pressure is proportionally placed on infrastructure that from the onset was not designed to deal with the requirements when it was initially developed. During flash floods, property could be damaged and lives could even be lost, as the infrastructure has either not been maintained or is inadequate.

Reference is made to compliance with the *First Draft National Spatial Development Framework* (NSDF Draft) concerning spatial outcomes for a post-apartheid South Africa.

Firstly, attention is drawn to NSDF Draft National Spatial Outcome Three: “National Connectivity and Movement Infrastructure that makes reference to the importance that systems are strategically located, extended and maintained, to support a diverse, adaptive and inclusive space economy and key national and regional gateway cities and towns. National water and energy-distribution infrastructure are therefore expanded, upgraded and maintained to ensure national water and energy supply and distribution are rendered” (NSDF Draft, 2019: 100 - 101).

The researcher argues that when natural disasters happen, the local government should have a plan in place, as well as resources that can be mobilised to deal with the fallout. It is opined that man cannot control natural disasters, but man can plan for such events so that damage to property and infrastructure is minimal. Some thought must, therefore, be applied when doing new spatial design for cities and towns to determine how existing infrastructure can be adapted or worked around to cope as best as humanly possible when natural disasters do happen. Planning and infrastructure development must be done at the town planning level to ensure that future events can and will be accommodated.

National Spatial Outcome Five of the NSDF Draft (2019: 101) makes specific reference to planning that must be done at all three tiers of government. This planning must ensure long-term water supply from well-oriented and coordinated strategic and sectoral planning processes at the state, provincial and municipal levels and should concentrate on national and intergovernmental regional water interdependencies. It is envisioned that planning to ensure water security should be done at all three tiers of government, as each has a role to play in ensuring South Africa is water-secure in the future. It is therefore important to take note that this very aspect of co-operative planning is referred to under chapter three of the Constitution of South Africa. Under the heading, Co-operative Government, article 41 addresses principles of co-operative government and intergovernmental relations. In subparagraph 1.c, it is stated that: “[All spheres of government and all organs of state within each sphere] … must provide an effective, transparent, accountable and coherent government for the Republic as a whole” (*South Africa, Constitution of SA Act 1996, art 41: 22*). Among other responsibilities, the CoGTA contributes to improving people's living standards by expanding the provision of clean water, electricity, wastewater treatment, waste management, education at all levels, healthcare, all freely given to the vulnerable and needy (Department CoGTA, 2019: 5). In preparing for natural disasters, the CoGTA has a key role to play in the process to coordinate and facilitate capacity building and overall preparedness to serve the people.

A drought governance system — including a drought management plan — is a critical prerequisite. This plan should be rolled up from the municipal level, district, metropolitan,

provincial and finally national level. This plan should not only exist on paper, but should have resources allocated to ensure implementation. For the latter to happen, it is important for the conceptualisation, drafting and implementation of policies to take place. Drought management must be performed in various sectors (technical, political, public opinion, legal) and must include professional expertise to address inherent institutional complexities and confusion, institutional dispute resolution mechanisms, and supply and demand management. Allocation and restriction/rationing policies should be drawn up before droughts occur and implemented by local government structures, including public participation (Muller et al., 2018: 34).

There is a good argument for the government to step away from traditional dependency on post-impact rescue, recovery and reconstruction measures (Butler, 2019). A more systematic and constructive strategy could reduce the impact of climate disasters by employing prior planning and mitigation measures already developed (Butler, 2019). According to Agri Northern Cape, the Western Cape, the Eastern Cape, the Northern Cape and the Limpopo area should have been declared a disaster area during the previous year in 2018 because of the ongoing drought in the region (Moubray, 2019).

4.2.3 Summary of the themes

The first main theme referred to the human factors threatening water security that should be managed through continued intervention at local government. In the process of analysing this main theme, five sub-themes were identified and discussed in more detail:

- Fiscal management,
- Managerial and leadership capacity at local government,
- Skills shortages and building human capital for the future,
- NRW, infrastructure development, planning and maintenance, and
- Water provisioning, prevention of pollution and water standards.

The second main theme referred to planning for the management of unpredictable potential environmental threats so that local governments are better prepared and can respond more effectively when they occur. This covered the following two sub-themes:

- Drought planning and the use of technology
- Early warning and disaster management.

4.3 CONCLUSION

In this chapter, analyses and a discussion were presented to draw attention to the shortcomings or lack of sound management practices at local government level, with specific reference to the management of water resources. The link is made between the management

of water resources and how this is placing the people of South Africa at risk, as water insecurity was always unimaginable in the past and is now facing the country head-on. Based on the facts presented in this study, it is evident that the country needs fundamental reconsideration of the water sector and water's place in the economy.

Drought is a socio-natural phenomenon; its management is complex and requires different sets of skills and expertise to initiate and broker sustainable solutions. Any plan or solution should go hand in hand with the buy-in from the government at all levels, the private sector, as well as the public, as some decisions might be very controversial at times and might be rejected by some segments of society.

Consequence management is not properly applied by any of the three tiers of government, as several instances of transgressions involving abnormal, fruitless and wasteful expenditure were only taken up by the government structures implicated after review by the Standing Committee on Public Accounts (AGSA, 2018: 22). This brought about the current state of affairs – poor governance, inadequate planning and resource management, poor and inadequate infrastructure maintenance and development. This trend is compounded by skills shortages and continued inertia with regard to a turnaround strategy with timelines and objectives that are actually enforced and tracked at local government level.

The country's water resources are the foundation of the economy and the way people live in South Africa. There is no substitute for water. If water sources are degraded, downstream, supplies and development will come to nothing in the future, as demand will outstrip supply. Development is still planned without considering this essential 'ecological infrastructure', such as wetlands and aquifers that must be kept pristine so that they can continue to supply good quality water to communities. A water-secure future demands that water-source areas, the 8% of the land that produces 50% of the river flows, be given special priority. Water-source areas should at all cost be kept free from mining and development encroachment and pollution (WWF-SA, 2016: 3).

Without adequate monitoring and evaluation of the data pertaining to the state of the country's water resources, it is not possible to manage the implementation of plans, understand trends and adapt objectives proactively with an eye on the horizon. Therefore water provisioning during protracted regional droughts will become increasingly problematic, with catastrophic consequences for all the people of South Africa. This is particularly critical in an environment facing significant change.

The correlation between the ineffective planning and inadequate skills pool stuns observers and derails development plans on water and sanitation infrastructure. It would appear, based on the feedback given to the Portfolio Committee on Water and Sanitation, that

there is a sentiment that "… there was a huge problem with the skills within the Department of Water and Sanitation, and if critical posts can remain unfilled for more than five years, it does not matter how good our plans are, as they will not be implemented" (Portfolio Committee on Water and Sanitation, 2018: 12). As long as this sentiment prevails, stagnation will persist, and skills shortages will remain a problem in all government structures.

It appears as if good governance remains a problem throughout government structures at all levels of government. The AG SA is correct in saying:

> "As long as the political leadership, senior management and officials do not make accountability for transgressions a priority, irregular, unauthorised and fruitless and wasteful expenditure, as well as fraud and misconduct, will continue. An environment that is weak on consequence management is prone to corruption and fraud, and as a people, we cannot allow money intended to serve the people, to be lost! Most auditees have the required policies and processes to ensure that transgressions and fraud are identified and acted upon, but chose not to use it – a clear indicator of a lack of commitment to accountability" (Auditor-General Report SA, 2018: 35).

Any strategy or policy formulation (from conceptualisation, planning and implementation of policy, including a feedback trail to integrate public interest and service delivery with performance assessment) is essential in the establishment of the developmental and transformative state. As Mulaudzi and Liebenberg (2017: 48) concluded: "South Africa, assuming we are a developing state, is by no means there yet – in fact, we are on the cusp between definite failure and potential progress".

The next chapter addresses the nexus with climate change, water security and local government. This is followed by arguments on drought planning and the use of technology at local government. Finally, the chapter concludes with lessons learnt from Cape Town's Day Zero experience where applicable recommendations are offered.

5

THE NEXUS BETWEEN CLIMATE CHANGE, WATER SECURITY AND LOCAL GOVERNMENT

"There are only nine meals between mankind and anarchy" Alfred Henry Lewis, March 1906, *Cosmopolitan Magazine*.

5.1 INTRODUCTION

In this chapter, the nexus between climate change, water security and the local government is discussed. In doing this, attention is drawn to the possible impact of the consequences of climate change on water insecurity and the impact climate change might have on human settlements. Climate change is an environmental factor and municipalities have a crucial role to play in mitigating the effects of this phenomenon. The state of the environment allows people to live and breathe air, work and earn a living, practise agriculture and produce livestock and other produce for consumption, manufacture goods, deliver services and practise leisure activities. Without a favourable environment in which to practise all these activities, life will cease to exist. The local government is responsible for service delivery closest to the people. It is therefore responsible to create and maintain an environment that is safe and conducive for people to live and prosper. The management of resources and infrastructure at this level, has a direct influence on the quality of life of the people dependent on proper service delivery.

Senator Al Gore, one of the most outspoken politicians in the climate change controversy, broadened the climate change debate by passing the following comment: "We will see as a nation and a government that America's future is inextricably linked to the fate of the world". Even the future of South Africa is inextricably tied to the fate of the rest of the world. The state of the environment is in fact becoming a matter of national security. It is an issue that directly and imminently threatens the national interests of all nations across the globe and their way of life (Campbell & Parthemore, 2016: 4).

The consequences of climate change are complex and wide-ranging, so are the security threats. As concluded in the IPCC's *Fifth Assessment Report*, climate change will, among others, slowly endanger human security. It will lead to factors that increase the likelihood of

armed conflict. It will have an impact on critical transport, water and energy resources and progressively influence conditions affecting security and national security policies (Mobjörk & Smith, 2017: 2).

The effect of climate change on human settlements varies on a scale from minor events to catastrophic disasters. The effect is greater losses more frequently – particularly for the poor. Climate change also affects changes in environmental conditions that are bound to have long-term consequences for human settlements (Faling, Tempelhoff & van Niekerk, 2012: 2). Consequently, it is the government's responsibility to prepare for climate change adaptation and mitigation to reduce the vulnerability of people, infrastructure and other national assets to climate change. Government should also protect development gains and increase social justice by 'reducing the shift of environmental costs to other people, other ecosystems or into the future' (Bulkeley & Betsil, 2005:2; Satterthwait, 2005:2, as cited in Faling, Tempelhoff & van Niekerk, 2012: 5). Following disasters such as cyclones and droughts, municipalities in developing countries suffer significant setbacks in the hard-earned economic and social development environment. Governments typically lack the ability to predict, track, prevent and handle hazards and disasters (Faling, Tempelhoff & van Niekerk, 2012: 5).

Faling (2008, as cited in Faling, Tempelhoff & van Niekerk, 2012: 9) found that such sentiments regarding disaster risk management are not expressed to the same degree of gravity in policy and legislation relevant to spatial growth planning and climate change, as stated in some policies. Hence, disaster risk management and climate change continue to be among the most overlooked problems on the national agenda or development planning agenda. This is echoed by the planning approaches for regional and municipal growth. Studies (Basson & Horak, 2009; Dlamini, 2009; Pewa, 2009; Ferreira & Fritz, 2009; Van Wyk & Delport, 2008, as cited in Faling, Tempelhoff & van Niekerk, 2012: 9) have shown that the only province in South Africa with a climate change policy is the Western Cape Province, and the coastal cities of eThekwini and Cape Town are the only metropolitan cities with climate change strategies (Faling, Tempelhoff & Van Niekerk, 2012: 9). This is a disconcerting indication of the misappreciation from local government of the impact and perceived level of threat of climate change on South African society.

Another barrier to reform is that many municipal officials may not have a clear grasp of the science of climate change and the impact of climate change at municipal level (Faling, Tempelhoff & van Niekerk, 2012: 9). They are highly unlikely to have the ability to acquire the comprehension, considering their workload. Municipalities may often face environmental issues that are more urgent than climate change mitigation (although these may be interrelated). Many obstacles involve allocating committed human and financial resources to

climate change management, struggling to adapt to climate change through technology, integrating climate change considerations into strategy and not having a political champion to drive the climate change initiative at local government level (Roberts, 2008: 525-527, as cited in Faling, Tempelhoff & Van Niekerk, 2012: 9). Research (Faling, Tempelhoff & Van Niekerk, 2011, and Van Niekerk et al., 2009, as cited in Botha, Van Niekerk, Wentink, Coetzee, Forbes, Maartens, Annandale, Tshona & Raju, 2011: 35) suggests that communities ought to recognise climate change and adaptation problems as part of their growth plans and as an important part of their disaster risk reduction mandate.

5.2 IMPACT OF CLIMATE CHANGE ON LOCAL GOVERNMENT AND WATER INSECURITY

In the previous section the aim was to enlighten the reader to the realities and the barriers to adaptation at local government level. If no planning is done for the future with regard to the effects of climate change, the consequences of inaction will be far worse within society. Preparations done now will be challenging and costly but it will be worse if no planning and preparation are done at all. The following section elaborates on the dangers and the risks involved if planning and preparation are neglected.

Food, energy and water are "the foundations of global security, prosperity, and equity" (Hague, 2010, cited in Willis, Groves, Ringel, Mao, Efron & Abbottet, 2016: 1). Energy generation is the backbone of human development. The provision of clean water, sanitation, and healthcare requires access to modern forms of energy. Energy offers excellent advances by providing safe and efficient lighting, heating, cooking, mechanical power, transportation, communication, information technology and cooling (Haines, 2007; International Energy Agency, 2010, as cited in Willis et al., 2016: 1). As energy also plays a vital role in the tri-nexus between water, energy and food security, the importance of energy in water management and water supply becomes key to economic development, well-being and food production. Energy plays a crucial role in ensuring water security. Electricity is required to get potable water to the end-user, but in the process of generating fossil fuel and nuclear electricity, vast quantities of water are required to generate electricity.

To use an example: When Medupi and Kusile power stations finally achieve optimum power-generating efficiency, this capability is focused on the premise that there will still be ample water available for their operation. Each power plant will consume no less than 26 million m^3 of water per annum when operating at full capacity (Overy, 2020). By 1983, South Africa was still in the midst of extreme drought, which had a devastating effect on Eskom's coal-fired fleet of power stations in the early 1980s. In May 1983, at Megawatt Park in the then Transvaal and Natal provinces, Eskom organised a power rationing conference to inform

leaders of all major consumer groups about the problems it faced as a result of severe drought (Overy, 2020). It is also important to note that when burning fossil fuel, electricity generation consumes at least 3 000 litres of water per MW/h compared to renewable energies, which consume 150 litres per MW/h in a worst-case scenario (Overy, 2020). It would appear as if history is repeating itself, as droughts are cyclical, and South Africa has not learnt from its mistakes to ensure water security.

Water security has been defined as: "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies" (Gey & Sadoff, 2007, as cited in DBSA, 2012: 2).

Water security also refers to the amount of 'slack' or buffering[16] that is available in the natural resource supplies to allow a nation to accommodate long-term changes and adapt to short-term disruptions in the water supply (Willis et al., 2016: 9). Calow et al. (2010:246) referred to buffering as the same concept as 'slack' as an essential criterion when assessing a nation's water security status. This 'slack', as defined by Willis et al. (2016: 9), is also referred to as a nation's adaptive capacity spread over time in terms of water insecurity. It is therefore argued that in the case of South Africa as a whole, provinces such as KZN (27 municipalities), Limpopo (two municipalities), North West (17 municipalities), Mpumalanga (15 municipalities), Western Cape (25 municipalities), Northern Cape (24 municipalities) and the Eastern Cape (16 municipalities) have been adversely affected (Agri SA COE, 2019: 12) by the 2019 drought. This is by far the worst drought in more than 100 years and in some cases during the 2018/19 drought, towns' municipal water supply dried up, for example in Graaff Reinet, Beaufort West, Adelaide and Makhanda (Ritchie, 2018; EWN Reporter, 2019; Patter, 2019).

The habits of people are changing consistently under new permutations of climate change, and weather patterns (droughts and floods) seem to become increasingly unpredictable. As drought will become the new normal, a large body of scholarly research suggests that climate change will change the way economies are driven and how people will live. It is therefore prudent to state that research will support the notion that the future may not resemble the past in a big way. Part of the problem is that South Africa does not know what it does not know regarding this phenomenon.

The water sector cannot, by itself, guarantee water security. This sector cannot solve the problems of informal settlements where, for example, proper sanitation is virtually

[16] Aquatic ecosystems need water quantity and quality to survive and grow and play a vital role in buffering people in times of drought and long-term climate variation. Water over-abstraction, e.g. for agriculture, urban and industrial use, and water pollution put these resources at risk (Skowno et al., 2019: 4).

impossible. It cannot discuss the needs of the disabled or those with special needs. It cannot avoid building houses on floodplains, putting whole neighbourhoods at risk of catastrophe, without the assistance of urban planners. Water security needs concerted action across a variety of sectors and institutions and cooperation between civil society and the community at large (Muller et al., 2018: 8).

Mobjörk and Smith (2017: 2) see climate change as a “process of transformation”. It involves both solutions to problems not previously experienced in human history, such as sea-level rise and other phenomena such as droughts, heavy precipitation, cyclones, and heatwaves. Consequently, climate change brings about many uncertainties (Mobjörk & Smith, 2017: 2-3). With uncertainties come change and adaptation in the way we live.

Thomas Homer-Dixon, argued that environmental change would affect societies by "decreasing economic efficiency and disrupting institutions that will jointly contribute to relative-deprivation conflicts. It can be argued that [relative-deprivation conflicts] may cause, ‘further economic deterioration’ and institutional dislocation". Joseph Romm reiterated this concern in 1993, saying that the situation in many resource-limited nations "may result in conflict or ecosystem collapse, leading to environmental refugees ..." (Campbell & Parthemore, 2016: 13). Moreover, climate change is already projected to have significant adverse effects in terms of temperature change and reduced rainfall forecasts in countries north of South Africa and into Central Africa. Theoretically, such developments could lead to large-scale regional immigration of 'environmental refugees' from these countries to South Africa and neighbouring counties. South Africa would therefore require both mobilisation and infrastructure planning and would have to put protocols in place to deal with these eventualities. This must be done with a view to avoiding the kind of antagonism and open animosity that refugees from Africa, the Middle East and Asia are steadily facing in parts of Europe (NSDF Draft, 2019: 56).

Regarding the impact of climate change and the resulting proliferation of refugees on the African continent, Burkina Faso, Chad, Mali, Mauritania and Niger are strong examples of this trend. These aforementioned countries in the Sahel Region of Five (also known as the G5) countries are facing some of the worst effects of climate change. These include higher temperatures, more regular droughts, prolonged heat waves, soil erosion, increased floods and reduced productivity in agriculture. The region recently recorded the most severe and persistent decrease in rainfall worldwide. Communities in this part of Africa depend on pastoralism and rain-fed agriculture. The G5 is now faced with exponential population growth, abject poverty and underdevelopment, violent terrorism, organised crime, incompetent governance and weak institutions, exacerbated by the impact of climate change (Mbiyozo,

2020). According to Mbiyozo (2020), it is difficult to make accurate predictions to what extent climate-related Sahel migration will occur. The media and scholars predict large waves of up to one billion migrants that will be displaced by 2050 on the African continent.

Considering the importance of the matter from a regional viewpoint and the obstacles that will need to be met, it is important that a 'national spatial climate mitigation strategy' be prepared to ensure the following (NSDF Draft, 2019: 56):

- The involvement of all stakeholders such as civil society and the government structures concerned;
- Clear urban planning guidelines;
- Environmental impact analyses reports;
- Land-use management elements;
- Law enforcement;
- Securitisation of resources such as food, water, and shelter; and
- The required funding for such a plan with the assistance of the international community.

A recent report by the World Bank on Sub-Saharan Africa, South Asia and Latin America, forecasts that climate change will cause tens of millions to migrate within their countries by 2050. It also reports that "without meaningful climate and development intervention, just over 143 million people would be forced to flee inside their own countries in order to escape low onset of climate change" (The 2020 World Climate and Security Report, 2020: 11). They are expected to migrate from less secure areas with less water resources and diminishing agricultural production, especially areas threatened by rising sea levels and storm surges (The 2020 World Climate and Security Report, 2020: 11).

Although countries do not go to war for water, people risk their lives every day because of inadequate water management, limited access to clean water and even violent water conflicts in their own communities (Risi, 2019). In similar fashion, service delivery protests in South Africa have become common in a variety of communities whose economies have been affected by the consequences of the ongoing drought.

An illustration of the impact of lack of wastewater treatment in combination with diminishing river flows is the public health issues Iraq experienced in mid-2018 in response to inadequate water quality and lack of wastewater treatment. Thousands of Basra city people fell ill after ingesting contaminated water. Because of the lack of public infrastructure, high unemployment, water and electricity shortages, and widespread corruption, protesters took to the streets in violent protest. Water contamination derived from both the general absence of

wastewater treatment[17] in Iraq and decreased river flows in the Tigris and Euphrates Rivers that caused saltwater from the Persian Gulf to intrude these rivers, destroying freshwater and valuable farmland. This forced people to flee their homes and abandon their livelihoods, with catastrophic economic and humanitarian consequences, causing hardship for Iraq and its people (Campbell & Parthemore, 2016: 14; Schmeier & Iceland, 2020).

In South Africa, this will become a reality, as coastal developments will start to fall prey to seawater intrusion, especially during storms and high tides. Economies under the coastal water line will falter, as the sea will rise and claim the land.

In times like this, it would be in South Africa's interest to look at water security from a regional perspective, as riparian states share river basins with South Africa and therefore water security should be lifted onto the African agenda to seek solutions for the region. It is argued that people should not be allowed to migrate to another country and exhaust that county's already strained resources. It is in everybody's interest to plan for and implement mitigation strategies to ensure populations remain where they are and can make a living and survive difficult times for as long as possible. The effects of climate change will force nations to combine their efforts to look at smart agriculture and the use of technology with drought-resistant crops to ensure food security. In future, water will have to be utilised sparingly and in smarter ways to ensure the survival of people. The same will have to apply in riparian states.

Securitisation of water resource management is inherently counterproductive (Turton, 2003: 83), and Turton argued that it undermines institutional development by weakening the extent to which hydrological data is shared between all riparian states. Consequently, if the dispute is to be mitigated because of water scarcity in the Southern African region, then the control of transboundary rivers ought to be de-securitised. Turton (2003: 83) shares the view that control of transboundary rivers must be placed in the formal political domain where it can be discussed freely; a healthier environment would result in viable options for all parties to explore.

Sharing water resources among various users and protecting those resources from contamination are difficult challenges. For example, people who do not want to restrict their use or protect the resource will use an upstream water supply, and thus their actions will affect downstream users. Indeed, when rivers cross political and administrative boundaries, some water management problems require a polycentric approach to governance (Ostrom & Hess,

[17] In this case, shortage of water was not a problem, but the destruction wrought by forceful foreign military intervention. There was quality water available before, but plants and water infrastructure were destroyed by military means.

2007, as cited in DBSA, 2012: 2). Consequently, successful governance by riparian states of this ‘common pool resource’ is essential to ensuring water security (DBSA, 2012: 2).

In total, 60% of the river basins in South Africa have water flow to or from another country The headwaters of the Orange-Senqu flow from Lesotho, and tributaries that flow into the Pongola come from Swaziland. The Limpopo and Inkomati Rivers flow towards Mozambique. The Karoo aquifer sequence in the Kalahari is a major transboundary advantage shared with Botswana and Namibia. South Africa has contractual responsibilities under the National Water Act (South Africa, NW Act, 1998, as cited in WWF-SA, 2016: 8), ensuring a portion of the flow across our borders is sustainably controlled. As an upstream, downstream and riparian state, South Africa has various river sharing configurations (Muller, 2016: 11).

This means that the four most economically developing countries in the SADC region – South Africa, Botswana, Namibia and Zimbabwe – which are also the most water-stressed countries in the region, are locked in possible rivalry (or cooperation) partnership to control the common river systems. These river systems form the foundation of their respective economic development capacity, and therefore national security interests. Two of the main river basins in South Africa (the Orange-Senqu and the Limpopo Basin) are expected to be under stress by 2025, meaning that less than 500 m^3 of water will be available per person per year (NSDF Draft, 2019: 112). This is seen as a distinct component of regional political dynamics, likely to become a basic catalyst of either potential conflict or cooperation, with significant increases in regional drought development (Turton, 2003: 92-93). Transboundary cooperation on water can be an essential instrument for promoting cooperation between countries, which in turn promotes peace and security, economic growth and environmental sustainability (WWAP (UNESCO World Water Assessment Programme), 2019: 152).

To place the matter into context for South Africa, as Buzan and others (1998: 18, as cited in Turton, 2003: 90) noted: "[A] water crisis might become securitised on a global scale, but most likely the main battles would be regional. Upstream and downstream interests and other possible stakeholders from a single river or lake would see each other as both rivals and potential partners" (Turton, 2003: 90). This dichotomy of shared interest might feed into other regional rivalries and constellations, and thus become connected to a more general national security matrix (Turton, 2003: 90). Under these circumstances, national interest is the necessary driving power, with all states locked in competition, particularly concerning the survival of the state as an entity. Therefore, any acts that restrain the state in its unilateral search for control would be viewed as threats to its national interest and be regarded as risks to national security (Turton, 2003: 90). Based on the above, despite the shortcomings of this study, if emphasis is placed on water management at the level of local government, when a

drought is regional or continental, decisions made at the level of local government can never be made in isolation without considering the bigger picture. The repercussions of these decisions at the level of local government may have significant effects for riparian states. Therefore, foreign relations should never be excluded, to ensure the region's peace and stability.

IHE Delft Institute for Water Education and Partners (2020) advocate several key conditions that can contribute to reducing the risk of water-related security threats:

- Recognise and provide early warning and improved awareness of the scope and importance of water-related risks to key players.
- Strengthen stakeholder perceptions of the danger posed by these concerns to their own interests.
- Build the power base that stakeholders need so that they can intervene successfully.

IHE Delft Institute is of the view that under these circumstances, actors are most likely to intervene to avoid conflict development or societal destabilisation. It is argued that the role players will jointly undertake the inclusive and informed action required, resulting in reduced safety risks associated with water and improved management of water. This would usually promote stability and cooperation. Water can transform a means into an end. Rather than being an instrument of war, it may become a medium for peace (IHE Delft Institute for Water Education and Partners, 2020).

5.2.1 Drought planning and the use of technology

Water scarcity is on the increase worldwide. A third of the world's population resides in countries with elevated water stress levels, with droughts affecting over 50 million people a year, causing damage of more than $5 billion per year. These figures are expected to increase as population growth, accelerated urbanisation, increasing climate change and rising water demands exacerbate current demands. In certain cases, these threats are not simply a consequence of environmental changes, but are exacerbated by issues related to inadequate water management and governance (IHE Delft Institute for Water Education and Partners, 2020).

For South Africa to become secure in water supply, access to adequate water of acceptable quality is necessary for health, economic growth and social progress. It underpins the prosperity and development of South Africa and its inhabitants. The past two financial years have demonstrated how important water is for the sustainability and development of the South African nation (WRC Annual Study, 2017: 14). The challenges facing the South African water science community are obvious – transforming research, development, and innovation

(RDI) into realistic solutions to address poverty, inequalities, and unemployment while implementing technological solutions to boost economic growth opportunities, improve productivity and ensure sustainable development. Another critical aspect is building the resilience of society against future challenges, for example the consequences of climate change (Annual Report WRC, 2017: 14).

The prospect of increasing water shortages over the next decade has placed water in a position where it can pose the most significant social and economic risk to society. Many risks are global and have the capacity to have significant adverse consequences across countries and industries. This realisation highlights the need for innovative methods, technologies and processes, as well as highly qualified personnel. They need to be willing and able to face the challenge of tackling these challenges going into the future. The RDI roadmap was designed and co-created by the Department of Science and Technology and the Water Research Commission to address the issue of water-related innovation as well as skills requirements in the water sector in South Africa (Annual Report WRC, 2017: 26). In short, the RDI roadmap is a plan that is focused on investing in research, innovation upscaling and deployment, and the skills needed to achieve the ambition as set out in the roadmap. The roadmap broadly focuses on unlocking alternative water sources, governance, management of resources, supply and demand planning, unlocking new ways of management of built and ecological infrastructure, improving the water sector's business efficiency by dealing with NRW, as well as innovation in pricing, metering and billing. The roadmap was built by a comprehensive, systematic process to obtain orchestrated contributions from the technical group, review of the inputs and assessment of their possible consequences (WRC, 2015: i).

Over a ten-year term, the total expenditure commitment needed to accomplish all aspects of the RDI vision set out in the RDI roadmap for water is R8.4 billion. In 2015, R415 million was reported to have been invested in water research, growth and innovation. This indicates, according to the National Water and Sanitation Master Plan (2018b: 14-4), that there is a substantial annual deficit (about R400 million a year), which hinders the achievement of the RDI ambition in South Africa. Based on the details contained in the National Water Master Plan since the RDI roadmap was updated in 2015, it is uncertain whether the shortfall has already been resolved. It can also be stated that the National Water Master Plan was published in 2018 and cited the RDI roadmap that had been launched in 2015 already. There is no hint in the National Water Master Plan that the estimates had been updated to account for inflation and escalation of the cost of infrastructure. It is of grave concern that a proposal published by the DWS in 2018 was unable to work on data generated in 2015 concerning a crucial component of the National Water Master Plan to tackle water shortages and water usage in South Africa.

"We need to embrace the fact that water scarcity is the new normal, and all our future planning must accept that we are living in a drought-stricken area" - Patricia De Lille (Bisseker, 2017).

Planning and mitigating action to address the shortcomings or consequences of events that lead to food and water insecurity on such a grand scale that it affects the total population is not only the responsibility of any local government, but also that of provincial and national government. In the period before declaring a situation a disaster, it can be argued that the district municipality, according to the National Disaster Management Act, Act 57 of 2002, had to have consulted with the local or metropolitan municipality to determine any trends in rainfall patterns and should have acted upon this information well in advance. The process starts at the district municipality, which must consult with the local or the metropolitan municipality (Botha et al., 2011: 23). If water restrictions are not implemented well in advance, it points to poor governance, inadequate planning and poor management from the ground up. Each town, city and rural area in South Africa has a different disaster risk profile and therefore faces a variety of different threats of different magnitude. Because of lack of awareness, resources or political will, most South African municipalities are still focusing on a reactive approach to disasters and risk (Botha et al., 2011: 24). Cyclone Idai which took place during March 2019 is an example where South Africa as a member of SADC could have reacted earlier to render assistance (The 2020 World Climate and Security Report, 2020: 21).

Similarly, in cases of extreme drought, preparations must be undertaken well in advance to provide adequate water supplies and essential services such as sanitation. Based on population growth estimates, the population is growing and, by default, the demand for water is growing, while the availability of water is not increasing but remains seasonal. Planning for such extreme events remains the local government's responsibility. Drought contributes to water insecurity. When there is water insecurity, food insecurity sets in (Calow et al., 2010: 247).

For local governments to plan better for the future in terms of droughts, there is consensus that technology should be employed where possible to assist in better decision-making. To illustrate this, reference is made to the following locally developed technological innovation that will support local government in planning better.

A revolutionary electronic platform can facilitate the preparation and construction of climate-resilient settlements by the local government. The depth and scale of the data interpreted by the application have been recorded to be unparalleled in South Africa (CSIR, 2019: 54).

The Green Book Online Tool, co-funded by the Canadian International Development Research Centre and the CSIR, is the result of a three-year project in which the CSIR collaborated with South Africa's National Disaster Management Centre and other stakeholders and reviewers. This resource will contribute to stable, safe and liveable settlements in South Africa by allowing adaptation to climate change (CSIR, 2019: 54).

Key study results integrated in the platform include the country's most detailed projections (at 8x8 km² resolution) of potential climate change that can be expected and modern methods to measure the vulnerability of possible threats to settlements across South Africa, e.g. drought, wildfires, inland floods and coastal flooding. A vulnerability assessment framework was provided for all 213 local municipalities and 1 637 settlements across South Africa. The programme offers a population-potential growth model to forecast settlement growth patterns across South Africa. It also provides a menu of adaptation measures for consideration through the software that was developed (CSIR, 2019: 54).

In the researcher’s opinion, the 4IR has arrived and South Africa is still grappling with the basics. Technology should be used in the future management of water to assist with forecasting, and climate change prediction models. The Green Book is a good example of what the 4IR can do for every municipality in South Africa.

Climate change will continue to pose threats to South Africa's water resources. According to the CSIR (2019: 54), the Green Book analyses the effects of climate change on land and surface water and converts these into the threats facing district, local and metropolitan municipalities to provide water. This breakthrough will be a significant change for local councils by allowing them to prepare appropriately.

For local governments to benefit from such a technologically advanced system to aid in better forecasting and planning, the key lies in management and the foresight that a department with the necessary skills set will be required to manage. Active monitoring of climate change and rainfall patterns must be obtained and updated for the programme to be effective and give accurate guidance to assist in forecasting and planning better for the future. Accurate data means accurate forecasting. The adage comes to mind: “Garbage in, garbage out”. The accuracy of a computer model is dependent on the accuracy of the information that is fed into the programme. Furthermore, the secret of success will lie in the utilisation of the model and how a local government will use the results obtained from the model. The hope is expressed that this will become another success story for South Africa and its people.

5.2.2 Lessons from Cape Town and Day Zero

South Africa should learn from Cape Town's experience. Cape Town's latest water crisis (2018/2019) highlights the water supply difficulties in South Africa's challenging climate. This illustrates the significance and implications of project planning and modelling processes and the impact that ignoring the recommendations will have on society. A remarkable advantage of these models is that they demonstrate the threats presented by climate change and thus provide early warning of possible resource shortages and the need to implement water restrictions (Muller et al., 2018: 32).

During the recent crisis, the Berg River Dam construction, which was approved by Cabinet in April 2002 and eventually completed in 2009, rescued the City of Cape Town from the imminent 'Day Zero' misery. Yet the Western Cape network appears to be especially fragile, with less than two years' water storage available at average consumption levels. By comparison, Gauteng's IVRS has more than five years of storage and a 50 times greater catchment area than the Western Cape, which decreases risks related to future droughts and the risks associated with these events (Muller et al., 2018: 33).

In addition to the importance of swift investment in additional supply infrastructure, the history of Cape Town has shown how important rapid reaction is to evolving drought alerts. It also highlighted the need for specific restrictions and financial mitigation measures and efficient direct communication with all water users (Muller et al. 2018: 33). Similarly, it has demonstrated that while water conservation and demand management are important, the need to build new infrastructure in a growing South African city is not only vested in the city itself.

Another important lesson is that water security measures must take account of the interests of all users, not just urban residents. Western Cape agriculture requires approximately one-third of the water that is available in the scheme. It is a high-value operation in the region that creates many jobs and produces significant export earnings. The 'Winelands' is also an integral part of the region's 'name'. As a result, farmers continued to receive (restricted) water allocations even as city dwellers were considering 'Day Zero' (Muller et al., 2018: 33).

Cape Town's response was also weakened by the limited role played by the CMAs – the Berg/Olifants CMA had not yet been established at the time. The role played by the DWS Regional Office leading up to and managing the crisis was limited. The central strategic and coordinating role of the National DWS from an earlier onset, might have resulted in a different turn of events for Cape Town leading up to 'Day Zero'. Rather, it was left to the comparatively small DWS regional office of the Western Cape to deal with the matter, which aggravated the

lack of collaboration prevalent in all three tiers of government at the time, owing to political tensions (Muller et al., 2018: 33).

5.3 CONCLUSION

Increasing water scarcity poses the greatest societal and economic risk for the next decade. The 2018/19 and 2019/20 drought that crippled the Southern African agricultural and livestock farming community is an example of the severity of the region's crisis, affecting not just South Africa. Water scarcity is an existential threat to national security, as it has an impact both on South Africans' way of life and their quality of life. Water insecurity has a link of cause and effect to food insecurity, which in turn affects human security. Human security sits at the very heart of the South African Constitution.

South Africans' livelihoods have been highly vulnerable to water stress. Millions of people across the globe are plagued by the effects of water scarcity, such as unemployment, deprivation, food shortages and disputes about water and fodder. Water scarcity will heighten social unrest in deprived and vulnerable contexts, intensifying tensions and migration. There is an immediate need to understand the interrelationship between water and human insecurity. Above all, the ability to respond quickly and efficiently to avoid escalation will become key to maintain stability and control of people and resources (The Hague Centre for Strategic Studies, 2018).

National security becomes compromised when human security is under threat and the state can no longer ensure its citizens of safety and freedom from fear and want. In this scenario, lack of food and water is exacerbated by increased unemployment, a faltering economy, social insecurity and worsening health care conditions. The transition from a secure state where its citizens feel safe to a condition where the SANDF and the SAPS are mobilised to enforce law and order can change swiftly[18]. If people are hungry, they will break the law to feed their families. The risk is real. Post COVID-19 it is predicted that unemployment will increase by 1.6 million (some researchers predict more) positions that will be lost in the formal sector by the end of the second quarter of 2020 (Staff Writer, 2020a).

South Africa is dealing with the reality that its economy will contract 7.2% mid COVID-19 based on the latest calculations by Treasury (Ngalonkulu, 2020). A weakened economy on top of a protracted regional drought, with massive foreign debt in excess of R3.56 trillion

[18] It is foreseen that the (widening) civil-military relations gap and the image of the SANDF and SAPS will come under scrutiny at some stage. If they are seen as negatives through their actions, they alienate citizens and bring themselves into disrepute. In the longer term it implies lack of legitimacy or a legitimacy crises for both state and its security forces. An economic fragile state (as South Africa is experiencing at present) can hardly afford an increased lack of legitimacy as well.

(Head, 2019; Deloitte, 2020), does not bode well for South Africa. The struggling and technically bankrupt SOEs, including a power generation utility (Eskom) that requires water (apart from coal) to generate electricity and has debt of more than R420 billion, are adding to South Africa's cash flow dilemma. It is still unknown how much out of pocket the COVID-19 pandemic will leave South Africa, as it is predicted that the impact will be felt for some time to come. It is suspected that the cost will be dear to short-term cash-intensive projects, as many developmental projects will be postponed. If South Africa will ever recover remains of concern.

Any delay in action now will increase budgetary costs in the future. On top of this, one must factor in the effects of climate change. The scientific world can warn that changes in the climate will take place, but the effects on the environment and the duration thereof are still unknown. People are learning as they proceed. As a people, South Africans need to manage this resource for which there is no substitute.

This chapter has made the following clear:

- South Africa is not water-secure, and the resources to achieve water security are sorely lacking.
- Local government has an especially important role to play to ensure water security.
- Climate change will bring about change. The magnitude and impact on society are not yet clear, but predictions point to apocalyptic consequences for Africa.
- Technology is available to assist local government to prepare better for the effects of climate change.
- Early warning is key to effective disaster management planning and mitigation.
- Lessons have been learnt from the Cape Town Day Zero experience. These lessons should be taken to heart and applied.

The following and concluding chapter comprises a discussion on the findings and recommendations proposed as possible solutions to or alternative options to mitigate areas of concern in the management of water resources and infrastructure at local government level.

6

FINDINGS AND RECOMMENDATIONS

"Those who cannot remember the past are condemned to repeat it" — George Santayana 1905.

6.1 INTRODUCTION

In this final chapter of the study, findings and recommendations are made based on the analysis of management practices of water resources and infrastructure at local government level as a threat to water security in South Africa. This study was conducted using a qualitative descriptive approach and included an extensive literature review.

This study aimed to identify and describe major themes and sub-themes that can be categorised as threats to water security with specific reference to management practices pertaining to water resources and water infrastructure development and maintenance. These manifestations of threats to water security in South Africa at local government level have the potential, if not managed appropriately or ignored, to affect the national security of South Africa adversely. Reflecting upon these threats, the researcher aspired to develop recommendations to circumvent or at least minimise them, should they occur.

The fundamental research problem justifying the study was asked in question format: **"Are the management practices of water resources and infrastructure at local government level a threat to water security in South Africa?"**

Based on the research problem, three research questions were formulated. These questions are related to the aim and objectives of this study, namely:

1. What are the human factors at local government level that can have an adverse effect on water security and should be managed through continued intervention?
2. Which environmental factors may have an impact on water insecurity if left unchecked and should be planned for at local government level?
3. What are the proposed recommendations to prevent water insecurity at local government level?

Management theory (discussed in Chapter 3) linked to the research questions indicates that at the centre of South Africa's imminent water security problem lies the matter of management or in some cases lack of proper management of the factors causing South Africa's water insecurity. Such an example is the history of the Vaal River sewage spillage that

was first reported as far back as 1997. The politics in the background leading up to Day Zero in the Western Cape had a similar effect. In the latter case, many lessons were learnt on what to do and what not to do during a prolonged drought. Agri SA believes that assistance to farmers during the current drought is managed in a reactive instead of a proactive manner. Similarly, Cyclone Idai and similar disasters that took place in South Africa over the years have been handled reactively. Poor planning played a role in how these events were handled and therefore a case is made that properly funded plans should be put in place to handle such events proactively.

Chapter 4 made a case for distinguishing between human factors threatening water security that should be managed through continued intervention at local government and secondly, potential unpredictable environmental threats that should be managed or planned for when they do happen. In both these categories, poor management practices or lack of management is evident. Lack of funds or shortage of funds to do research or to initiate new infrastructure projects does play a role, but the situation is exacerbated by poor management and control practices, non-compliance with the PFMA, or redirection of existing funds for water projects to other projects at local government level. Problems are further exacerbated by non-payment for water consumption by users and the way in which the local government manages this phenomenon. Poor management and leadership practices, coupled with the absence of governance, lie at the heart of the dismal state of water management at local government level. These phenomena not only impact negatively on the way we live as citizens but also place a damper on progress and economic development for all who live in South Africa.

Chapter 5 closed the loop by discussing the nexus between climate change, water security and local government. Attention was drawn to the possible impact of climate change on water insecurity as well as human settlements. The crucial role of the municipality in mitigating the effects of climate change was highlighted. The chapter also addressed the importance of early warning systems and the use of technology in drought planning. Lastly, some thoughts were shared, and lessons learnt from Cape Town's Day Zero experience.

6.2 SUMMARY

This dissertation was divided into six chapters focusing on water security and water management in South Africa. As an introduction to the study, the first chapter identified the research theme, using an extensive literature study as a data collection method. The chosen research process (a literature review, qualitative approach and exploration of various themes) was deployed to determine the nature and impact of management practices of water resources at local government level. This approach was taken to determine what recommendations, if any, could be applied to overcome these shortcomings. Chapter 1 contextualised the study

and set the scene in terms of the research problem, the rationale for the study and the research objectives and research questions. This chapter concluded with the framework for the study.

Chapter 2 provided a comprehensive literature review on water resources in South Africa, the way in which these resources are managed and problem areas in the management of these resources at local government level. The literature review formed an important building block for the study. The literature review included literature such as books, chapters in books, edited works, journal articles, research reports, conference papers and government (including local government) reports, reports and communiques from acknowledged think tanks and related documentation. Where applicable, articles from newspapers were used as illustrative material, but were not treated as primary resources.

Chapter 3 expanded on the theoretical framework by using Fayol's management theory as a basis. Over time, management theories evolved and became more multi-faceted. This chapter expanded on theoretical and conceptual descriptive exploration of management. The available literature supported the research methodology that was used to analyse and identify categories (themes and sub-themes). This information was employed to make the connection between management theory and the current state of management of water resources at the local government level.

In Chapter 4, the results of data analyses were discussed. In Chapter 5, the nexus between climate change, water security and local government was explored further. The important role of the municipality in mitigating the effects of climate change was highlighted. The use of technology in drought planning was explored. Finally, this chapter concluded by looking at lessons learnt from the Cape Town Day Zero experience. Chapter 6, this final chapter, discusses pointers for future research and more critical context-relevant recommendations based on the data analyses of Chapter 4.

Data collection took place using an extensive literature review about water security globally and nationally, which tapered down to local government level until data saturation had been achieved. Data was organised into main headings (themes and sub-themes) to ensure clear understanding of the subject matter.

This final chapter presents a concluding assessment with findings and recommendations on how to deal with water security threats in South Africa. Water is a shared resource – it is not owned by persons or organisations. Therefore, it may be challenging to mobilise citizens and communities to take proper collective care of water resources. Increasingly, on the optimistic side (i.e. community involvement, public participation, political action), one finds several cases of communities, NGOs and governments joining hands in joint water action projects that generate a change in their catchments (WWF-SA, 2016: 91). Cooperative government and

public participation are becoming increasingly evident. Such initiatives may predict increased positive change for the future. Yet, as this study suggests, much remains to be done. To conclude, both the policy context and the operational context have been assessed in terms of the analytical framework.

6.3 FINDINGS

The findings are divided into two main themes. The first theme refers to human factors threatening water security to be managed through continued intervention at local government level. The second theme refers to planning for the management of unpredictable potential environmental threats so that local governments can be better prepared for such events and respond more effectively when they occur. The findings of the first main theme are discussed next, based on the literature that was reviewed.

6.3.1 Main theme 1: Human factors threatening water security to be managed through continued intervention at local government level

6.3.1.1 Sub-theme: Fiscal management

The analysis of current performance shows that lack of sufficient financial resources progressively limits the capacity of water sector institutions to maintain water security. All municipalities record substantial budget backlogs, whereas operating and infrastructure funding is still insufficient, inefficiently used or often redirected to unrelated municipal expenditure (Muller et al., 2018: 44).

Funding for projects to ensure water security will remain problematic for DHSW&S for some time to come. If water supply cannot meet demand, future growth and development, as well as drought management, will remain a problem for South Africa. The Minister of DHSW&S stated that the Department anticipates a R333 billion funding gap over the next ten years, and in addition to this, the DHSW&S reported a R59 billion refurbishment backlog (Mthethwa, 2019). Adding to the funding shortfall is the legacy of non-payment for services rendered in local governments. This is the result of a culture of non-payment to municipalities and poor revenue collection owing to weak administration in at least one third of all municipalities across South Africa[19]. Added to this is the matter of low economic growth forecast for South Africa, in tandem with increasing unemployment. The poor economic climate does play a role in the

[19] Municipalities increasingly find themselves in financial distress. Unauthorised use of water means non-payment. Non-payment implies a budget deficit for the municipality. A budget deficit implies low or no service delivery on the side of the municipality. It is therefore logical that perpetuation of this behaviour will result in a vicious circle that will continue unless action is taken against those who make themselves guilty of non-payment.

deterioration of municipalities' financial health but many municipalities are simply not managing their finances as well as they should.

Overall, the government is finding itself in financial distress. The situation is compounded by a debt-to-GDP ratio estimated at 65.6% share of GDP by the end of 2020/21 (Deloitte, 2020), and revenue collection shortfalls for the FY 2019/20 of R63.3 billion (Donnelly, 2019; Visser, 2020) in the current fiscus. The options available to the DHSW&S are limited, as it finds itself competing with 46 other government departments (47 departments in total) for the allocation of the annual budget. Treasury has indicated that revenue shortfalls are expected to total R251 billion in the coming three years (Donnelly, 2019).

Based on the above, it is the researcher's opinion that in a scenario where there is a prolonged drought, in combination with South Africa's international debt reaching 80% of GDP, earmarking surplus funds for capital-intensive projects to secure water will become increasingly difficult. The latter must be read in conjunction with the aftermath of the effects of COVID-19 on the South African economy. Given the fact that such a scenario is a possibility and adding the effects of climate change, e.g. mass migration, to the mix of possibilities, the national government might not be able to assist local governments through financial assistance for projects to remedy water insecurity. It would be a case of too little too late. The principle of continued spending over a sustained period to maintain current infrastructure and to make provision for constant upgrades and expansion of water-provisioning projects would be more manageable in the long term. In that way, skills, labour and finances can be secured in a controlled manner that will meet the demand.

6.3.1.2 Sub-theme: Managerial and leadership capacity at local government

One of the main foci of the study was not to analyse policies in detail, but to bring the role of management into the picture. Where policy was looked at, it was within the broader collage of the water-management process and the role of management within the South African context. Where applicable, the concept of management was linked to the issue of leadership. It became evident that challenges are being experienced on all three tiers of government. These challenges can be traced to inadequate skills or the absence of skills and managerial capabilities of people in decision-making positions. If there were qualified and experienced managers in critical positions who made sound decisions based on reliable information, the state of water affairs would have been on a surer footing. Water management in South Africa, on the contrary, seems to be lethargic. The budgets allocated to project managers with targeted outcomes should have been monitored continuously, and such managers should have accounted for their decisions and actions, employing an effective

feedback loop. Such a feedback loop would have given these project managers the ability to respond to feedback that was obtained and to implement corrective action where required.

It is apparent that municipalities are continually unable to deliver basic municipal services, frequently frustrated by the magnitude of their regional reconstruction and transformation challenges. The same applies to the relevant urban planning and urban transformation responsibilities, as well as land use management functions that resort with them. According to the available data, most municipalities find that they lack leadership, technical capacity and resources to carry out their mandates effectively (NSDF Draft, 2019: 73-74). Moreover, municipalities were not only hard hit by job losses and closures in struggling mining and heavy manufacturing sectors, but also lost their steady and substantial income from selling electricity and water to mines and factories. In many rural areas, municipalities have failed to establish concrete plans and achieve the necessary developmental effects, given their overwhelming scale of jurisdiction, the municipal capacity deficit to deal effectively with challenges and the enormity of their legacy backlogs (NSDF Draft, 2019: 73-74).

The annual reports speak for themselves (Muller et al., 2009: 5; Auditor-General South Africa, 2018: 22; Makwetu, 2019a: 3). There are centres of excellence where good governance prevails and decisions are taken in time, management principles are applied in good measure and funds are allocated and spent on time and within budget. However, in most municipalities (63%), the opposite is reported (Muller et al., 2009: 5; Auditor-General South Africa, 2018: 22; Makwetu, 2019a: 3; Njobeni, 2019: 2). The absence of management skills or limited management decision capability has been identified as contributing significantly to poor decision-making practices. Furthermore, evidence was found of non-compliance with governance, wasteful expenditure and generally dismal or inadequate management practices. As Muller et al. (2009: 5) correctly stated: "… not that there is not enough water. It is the management of the resource that is the problem".

Strong leadership and good governance are essential to every administration's success. Makwetu (2019b: 21) identified leadership as the root cause of dysfunctional communities. Specific reference is made to the position of municipal managers and their senior managers who are responsible for the governance and service delivery of the municipality, the municipal leadership (mayor and council members) who control the running of the municipality and make important decisions, and the regional leadership (premier, executive council members, and heads of provincial departments) that support the local government (NW&SMP, 2018a: 3-20; Makwetu, 2019b: 21).

The aspect of M&E is related to good governance practices, which form the basis of good management and leadership practices. Only through appropriate M&E methods can the

causes and effects of successes and failures be measured and accounted for. This, in turn, relates to the availability of data. If no data is available, planning for the future becomes guesswork. For example, municipalities need to know how much water they put into the system and how much is billed to determine how much water is lost or referred to as NRW (Muller et al., 2018: 21, 29; NW&SMP, 2018b: 34; Makwetu, 2019b: 10-11). Knowledge of how much water will be in demanded in the future should be based on indicators that have been identified and monitored. This can only be done through the availability of data and effective M&E programmes. Without adequate monitoring and evaluation of data pertaining to the state of water resources, it is impossible to manage the implementation of plans, understand trends and adapt objectives proactively in view of future requirements. Water provisioning during protracted regional droughts will become increasingly problematic, with catastrophic consequences for all the people of South Africa (NW&SMP, 2018b: 34).

When planning for the future, such data can be used in the spatial design phase for future development, knowing in advance how much water will be required in the short, medium and long term. To do correct planning, the collected data must be mined and utilised by municipalities to plan accurately for the future in terms of infrastructure development for housing, schools, hospitals, commercial hubs, water and sanitation. Through proper M&E practices, this data can shed more light on the extent to which plans must be amended and what corrective measures must be implemented to attain the desired outcome (Makwetu, 2019b: 10-11). CoGTA (2019) and the AG SA report (Makwetu, 2019b: 10-11) both refer to poor systems management in failing municipalities. This can be ascribed to inadequate M&E programmes, which in turn can be attributed to inadequate management practices by those in leadership positions in office. The previous Statistician-General stressed the argument that if no quantitative data was used to assess water and sanitation priorities, the policy rationale had to be challenged. The concerns he raised related to how departments develop a policy to determine priorities. Still, there is no evidence of data as a driver of policy-making (Portfolio Committee on Water and Sanitation, 2018: 12).

Consequence management as part of good governance practices has also been earmarked as a prime source of concern in failing municipalities (AG SA, 2018: 22; Portfolio Committee on Water and Sanitation, 2018: 7,12; South Africa, 2018: 12; Semenya, 2019; GCIS, 2019: 32; Makwetu, 2019b: 21). Based on the literature reviewed, a comparison was found between municipalities that showed no or little compliance with good governance practices and no or very little consequence management with regard to poor governance, financial misconduct or failure to deliver any services. In such cases, the implementation of oversight management would deter officials from continuing to act detrimentally or exercise poor judgement with regard to managerial decision-making processes. It became evident that

in municipalities where there was no consequence management, poor decision-making was reinforced, as there was no frame of reference to use as an incentive to do things differently or seek guidance from governance or adhere to policy guidelines. No consequence management equals a perpetuation of poor decision-making practices. From a management perspective, such a situation normally goes hand in hand with deviation from policy and poor judgement concerning decision-making practices. Performance auditing in the public sector, specifically performance auditing to account for better/good governance and oversight management at local government levels should be become the norm (Prinsloo & Roos, 2006: 86ff, 100ff, 108ff).

6.3.1.3 Sub-theme: Skills shortages and building human capital for the future

Drawing on a range of literature (CSIR, 2010: 43; Cilliers, Schünemann & Moyer, 2015: 8; South Africa, 2017: 8, 13, 16; Portfolio Committee on Water and Sanitation, 2018: 12; NW&SMP, 2018a: 5-14, 6-3, 7-8, 11-1, 11-3, 11-6, 17-3; Makwetu, 2019b: 10; Marwala, 2020), it is evident that there is a severe shortage of skills in the water management industry. The type of skills that are in short supply range from managerial skills to technical, professional and other skills. It has been established that these skills are in short supply not only at local government, but at all three tiers of government. From a career progression perspective, if a person is not area-bound, it implies that there are endless career opportunities in the water industry across South Africa. If the right people with the right qualifications and the right experience cannot be deployed at the right time and in the right place, all will come to nothing.

For South Africa to make progress in the water and sanitation industry, it is imperative to emphasise skills development and education, particularly as the country battles an almost 30% unemployment rate. One of the critical things that should be done is to invest in human capital in all three tiers of government. It is essential, then, for education to keep up with the changing face of work while aligning to the goal of sustainability. Already, the threat of the 4IR to jobs is palpable for both skilled and unskilled workers. The reality is that creating green industries will rely on highly skilled workers with specific training. The International Labour Organisation estimates that the green economy will create 60 million new jobs in the world by 2030 (Marwala, 2020).

It is further stated that there is a direct link between the poor and deteriorated state of infrastructure and planning. Lack of proper planning and management or inadequate capacity to manage the water resources of South Africa is instrumental in poor service delivery and in some cases no service delivery. It takes years to build capacity in terms of human capital development and to attract the right people with the right skills (NW&SMP, 2018: 11-1) into critical positions to address systemic shortcomings across the water industry. Muller et al.

(2018: 31) agreed that restoration of the municipal sector's technical capability, in particular, should be regarded as a priority to ensure South Africa's water security. The professional capacities of water boards and DHSW&S and municipalities need to be improved (Muller et al., 2018: 31; NW&SMP, 2018a: 11-6).

Drought management requires specific skill sets, proven expertise and innovative approaches, as well as coordinated water management structures. It is well documented that drought management actions will include supply management skills or features, demand management and dispute resolution, as well as monitoring of drought, including early warning capabilities (Muller et al., 2018: 34). CoGTA is mainly reactive in the management of the aftermath of cyclones, floods and drought relief management. Since there are so many cross-cutting interests within CoGTA and the DHSW&S, it would be beneficial for both these entities to find common ground to work closely together when it comes to forecasting, planning and drought relief implementation.

In the 4IR, there will be a demand for a combination of skills stacked upon one another and aligned to industry, which will allow people to enter and exit the system at multiple points as part of a lifelong learning process. Then, there is a need to invest in strategic projects for mass skills development, which can be scaled for exponential skills pipeline development and market absorption (Marwala, 2020).

This could be particularly effective in the manufacturing, agricultural and tourism sectors, which provide immediate opportunities for such programmes. Part of performance in 4IR is improving problem-solving capabilities, deepening analytical knowledge, multi-disciplinary thinking, consistency and most critically, mastering the social environment. The upshot is that all aspects of society need to be prepared not only to reskill but also to address skills as a continuous process, particularly bearing in mind that human beings need to move towards a green economy to survive as a species (Marwala, 2020). Artificial intelligence can assist in transforming traditional sectors and systems to address climate change, deliver food and water security, build sustainable cities, and protect biodiversity and human well-being.

6.3.1.4 Sub-theme: Non-revenue water, infrastructure development, planning and maintenance

In urban settlements, physical water loss due to leakage and other water losses accounts for more than 25% of the water supplied. Elimination is a simple and easily understood technique as a water management strategy that can reduce total water use and delay expenditure in delivering additional potable water supplies (although it will never be economical to eliminate all leakage in the systems) (Muller et al., 2018: 29).

Reducing water loss is generally a national concern. In his first State of the Nation address in 2010, President Jacob Zuma set a target of reducing water leakage by 50%. Successive ministers launched a programme called *War on Leaks*, supported by both the NDP and South African Local Government Association (SALGA[20]) mayors. The project was paid for through public-private sector partnerships. The strategy had no success, despite widespread interest and substantial budget funding. As part of this initiative, the DWS embarked on a campaign to employ out-of-school youths to train them as water agents, artisans and plumbers. The aim was to find and to stop water leakages where they lived. It seems as if the plan had not been well-conceived from the beginning. Ironically, the initiative lacked long-term institutional funding to guarantee its feasibility. The concept was worth the effort, but it lacked commitment (Muller et al., 2018: 29).

As debated by water professionals and illustrated in Cape Town, effective water loss reduction management involves a cohesive range of strategies through urban water supply operations. Municipalities ought to determine how much water they bring into their systems, and where it is used (or lost). Water losses must be managed. Muller et al. (2018: 29) provided an interesting argument by referring to the vigilance of effective management practices, which is a prerequisite to prevent water leaks. To be able to define and address problem areas, the supply network must be fragmented into smaller zones. In Cape Town, members of the public were encouraged to report water leaks and their ability to do so, strengthened by swift and effective reaction by the municipality to repair them (Muller et al., 2018: 29), strengthened and reinforced the proactive behaviour of all parties concerned.

Maintaining existing infrastructure is key. South Africa reports an average water deficit of 1 632.93 million m^3 a year (Annual Survey DWS FY 17/18, 2018: 36). The previous Water and Sanitation Minister, Nomvula Mokonyane, decided to stop monitoring and recording of water loss, which had a detrimental impact (Muller et al., 2018: 27). Approximately 39% of municipalities reporting their water deficits reported deficits of more than 30%, resulting in a gross loss of R2.6 billion (Makwetu, 2019b: 9). A significant proportion of households also profit from de facto 25 litres of free water per person per household of eight persons a day. This is also done in a way that creates a major debt crisis for the entire water sector, when households are billed but do not pay, as it creates a shortfall in municipalities' operating costs (Muller et al., 2018: 45).

Because M&E and reporting of NRW water are no longer taking place, municipalities have no idea how much water is placed into the reticulation system. They then also do not

[20] SALGA is the official legislated representative of local government and has a vested interest in the implementation of the Disaster Management Act and Policy Framework (Botha et al., 2011: 9).

know how much water is not billed for (in other words lost in the process of delivering water to taps). The researcher is of the opinion that only when a municipality knows how much water is lost, can plans be formulated to look for the sources of the leaks and do maintenance or take pre-emptive action. The income that must be generated from selling water to the end-user and collecting that revenue must be used for maintenance of current infrastructure as well as new infrastructure development. Under-collection of revenue from water sales to consumers is an opportunity wasted.

Where applicable, it would also be advisable for local government to plan for and undertake infrastructure maintenance at scale, to:

- Ensure economic rejuvenation and new development, and
- Avoid human health and safety risks due to ageing infrastructure, lack of maintenance and over-extraction of groundwater[21] in response to climate change.

Over-abstraction of groundwater can lead to the water table dropping, subsidence of ground in dolomite areas and boreholes drying up, with no alternative source of water available. Consequently, such actions contribute to damage to the environment due to limited sanitation services, stormwater maintenance and water supply to houses, schools, hospitals, business nodes etc.

6.3.1.5 Sub-theme: Water provisioning, prevention of pollution of water resources and water standards

South Africa faces a disparity between the expected demand in 2030 and the existing supply, equivalent to 17% of demand. Moreover, the impact of climate change may increase this gap (WWAP, 2012:317). In each of the basins feeding the most significant cities (Johannesburg, Pretoria, Durban and Cape Town), rivalry for limited water supplies will be stepped up. The demand from households is projected to increase as a consequence of an expected increase in personal income and improved service reach by municipalities (WWAP, 2012: 317).

Indications are that South Africa is coming to the end of its additional water supplies that can be harnessed economically, as well as of the “dilution capacity” of its water resources to remove waste (Van Der Merwe-Botha, 2009: 5). If the prevalence of water-borne diseases is high, whole towns or cities can become infected, which in turn can cause deaths or losses to

[21] Groundwater is usually cheaper to process for use in comparison to alternatives, and aquifers have been documented to be able to provide natural protection against contamination (Calow et al., 2010: 247) when recharged.

the economy owing to people falling ill and businesses being unable to remain viable (Roux, Oelofse & Lange, 2010: 2). The economic impact of polluted surface water resources includes the cost of treatment for reuse, loss of agricultural yields, as well as the loss of water storage capacity (Roux, Oelofse & Lange, 2010: 2) as surface water becomes increasingly polluted.

A World Bank study in Indonesia, by contrast, reports that the country suffered a loss of $6.3 billion (2.3% of GDP) from inadequate sanitation and hygiene in 2006. This has culminated in increased health costs, economic losses and offsetting of related costs in other markets (WWAP, 2012: 280). Water pollution in South Africa has been estimated to cost the country 1% of its annual national income (Pegram & Schreiner, 2010, as cited in WWAP, 2012: 280).

South Africa treats approximately 60% of its wastewater, and a substantial portion of its current infrastructure is in total disrepair for various reasons. Many water-scarce countries such as Israel and some Arab states use wastewater in efforts to augment the water supply. In 2013, 71% of wastewater collected in the Arab states was safely treated, 21% of which was used for irrigation and groundwater recharge (Connor et al., 2017: 9). Municipal wastewater use is a typical practice in the Middle East, North African, Australian, Tunisian and Mediterranean countries, China, Mexico, Guatemala, India and the US (Alfarra, Kemp-Benedict, Hötzl, Sonneveld, Ali & Wolf, 2009: 8; Connor et al., 2017: 8). Especially in China, Mexico and the US, this approach has been most popular in urban and peri-urban areas, where wastewater is readily available, usually free of charge, and there is a nearby market for agricultural products (Connor et al., 2017: 8).

The key benefits of wastewater treatment are primarily the reduction of purification costs for downstream users of polluted water, such as other towns, factories, farmers and the tourism industry. In extreme situations, water pollution has forced factories to be shut down and moved at a high cost rather than risking downscaled access to foreign markets for the export of agricultural and fishery products (WWAP, 2012: 280).

Wastewater management usually receives little social and political attention compared to water supply challenges, particularly in the context of water scarcity. Nonetheless, they are fundamentally linked – neglecting wastewater may have extremely negative effects on water quality, human health, the economy and the environment (WWAP, 2017: 17). With extraordinarily little wastewater being processed and much less being used after treatment, there is tremendous potential for sustainably reusing wastewater and harvesting some of the recoverable waste products it produces. Under carefully regulated conditions, the use of untreated wastewater offers excellent potential to minimise the pressure on freshwater sources, particularly in arid and semi-arid regions (WWAP, 2017: 19).

Small towns and small rural areas are not expected to experience a rapid increase in demography, nor are they likely to see a major population decrease in South Africa's medium- to high-density population growth scenarios (Staff Writer, 2020b). This would be the case particularly in major metropolitan areas where such growing numbers would put massive demands on already overburdened, declining and aged municipal infrastructure (Staff Writer, 2020b). At the same time, water demand management and the behavioural improvements and compliance procedures arising from this need to be adopted, policed and followed at municipal level (NSDF Draft, 2019: 54).

Should water supply remain unchanged, planning for extreme events such as droughts remains the responsibility of local government. Failure to plan for such events causes water insecurity and as a consequence food insecurity (Calow et al., 2010: 247). In terms of droughts and climate change events, there is consensus that to assist local governments in planning better for the future, technology should be employed where possible to assist in better decision-making.

South Africans are required to look differently at water management and water conservation to run homes, avoid disease transmission, practise agriculture and expand the economy. To satisfy demand and keep up with population growth beyond 2050, South Africans need to be innovative about how water is used and recycled for residential, commercial, agricultural and energy production purposes (Muller et al., 2018: 18). Rainwater harvesting in a domestic urban and rural environment is not the perfect permanent solution for continuous domestic water supply but can be used to complement domestic demand. Rainwater harvesting will also offer a valuable instructional and behavioural resource for schools where sound water conservation and usage principles can be incorporated into teaching and learning (Muller et al., 2018: 41).

What is evident right now is that South Africa is still not experiencing a total shortage of water. The degree of public reaction or total ignorance suggests a disturbing level of uncertainty about how water is accessed for consumption and what needs to be done to ensure adequate and secure supplies. Local government and residents need to understand and use water resources with more care and deliberation before water is used or contaminated with hazardous materials and pollutants such as motor oil, phosphates or poisons that are freely available to control pests (Muller, 2019).

While priority is always given to ensuring sufficient water supply, water security often depends on environmental protection and ensuring that the quality of water resources remains appropriate for use (Muller et al., 2018: 13). The Millennium Development Goals set ideals and provide guidelines. At the same time, they point to new imperatives on how to treat water,

the environment and the ecology. South Africa has achieved four of its seven environmental sustainability targets as set out in the Millennium Development Goals[22], of which two relate to the proportion of households with access to water and sanitation (Stats SA, 2015: 19).

Water pollution in South Africa is a growing concern, particularly as collapsed wastewater treatment systems struggle to cope with the rising domestic and industrial effluent from cities and towns. This represents the lack of consideration given to careful control and repair of wastewater infrastructure in most municipalities (NW&SMP, 2018a). It is estimated that 32% of municipalities responsible for water and sanitation do not determine the state of water and/or sanitation infrastructure and nearly half do not have maintenance policies (Makwetu, 2019b: 9).

In the absence of workable policies, it can be concluded that there will not be adequate maintenance plans. This initiates the question: “Why is this important mandate and responsibility in the hands of local governments all over South Africa allowed to degenerate and fall into total disrepair to the point that it becomes a threat to use it in its natural form?” Water is the lifeblood of the way people live, practise agriculture, enable the economy to function and generate electricity. This single denominator is the proverbial glue that is an enabler for health, economic growth and prosperity. There is no substitute for water, yet it is the most neglected resource in South Africa.

Emfuleni local municipality and Rand Water have developed an intervention plan to stop pollution of the Vaal River by repairing 44 pump stations and three wastewater treatment plants to prevent the pollution problem (defenceWeb/SAnews, 2019). To date, even with the assistance of the Defence Force, little progress can be shown with the prevention of further spillage of raw sewage into the IVRS (Monteiro, 2019).

In terms of managing and maintaining wastewater treatment works and associated sewage systems, the DWS monitored and controlled water standards via the Green Drop assessment. Unfortunately, in 2014, the DWS terminated the assessment and monitoring phase for Blue/Green/No Drop assessments, which indicates that there was little quantitative data on municipal technical performance or the data indicated that there was very little or no compliance with water standards (Muller et al., 2018: 21). In retrospect, this does seem to be an error in judgement, and concerted attempts should be made to reinstate the Green Drop assessment report.

[22] Performance against the eight Millennium Development Goals is assessed across 21 goals and 60 official metrics. Many of the Millennium Development Goals had 2015 timelines, using 1990 as the baseline for change (United Nations, 2015: 70).

In terms of water quality, it has been found that degradation of water quality is often due to damaged sewage collector mains and pump sets, as well as defective wastewater treatment works. The Green Drop assessment processes showed that most of these deficiencies are attributed to wastewater treatment facilities that work outside their design capacity or are operated by plant operators that lack appropriate expertise (NW&SMP, 2018b: 5-15). Muller et al. (2018: 23) noted that local surveys indicate that certain treatment facilities are not properly staffed and run, especially in smaller municipalities. It is the researcher's opinion that improved plant maintenance and skills development programmes should run hand in hand to ensure adequate bulk water and wastewater treatment and conveyance capacities at local government level with oversight management by CoGTA in conjunction with the DHSW&S.

CMAs are critical for managing declining water resources in South Africa, as integrated water resource planning is best achieved on a local catchment scale. CMAs were expected to serve as the administrative arm to implement South Africa's water policies and legislation (WWF-SA, 2016: 84). While there was initial excitement about proposals to create CMAs, the process proved to be more demanding than initially understood. Only two CMAs were established (of the planned 19), with various difficulties. The establishment process has been stalled in many other water-conservation areas. The original system is now being reviewed, and it is proposed that the number of CMAs be decreased from 19 to nine, considering the high cost of their establishment and the low number of qualified staff available to manage them (DWA, 2011, as cited in Muller, 2016: 36). The delays represent a lack of strategic continuity, owing in part to new ministers making extensive changes in the senior management cadre of the Department.

This lack of continuity has been identified as a common problem leading to low public service productivity in South Africa (NPC, 2011, as cited in Muller, 2016: 23). This political trend is apparent in the water supply management sector, which is highly specialised and relies on both understanding of the technical issues and other complexities that the water sector faces every day and their specific histories (Muller, 2016: 23).

The findings of the first main theme that referred to human factors threatening water security that should be managed through continued intervention at local government level were discussed under the following headings:

- Fiscal management,
- Managerial and leadership capacity at local government,
- Skills shortages and building human capital for the future,
- NRW, infrastructure development, planning and maintenance, and
- Water provisioning, prevention of pollution and water resources.

The findings of the second main theme referring to planning for the management of unpredictable potential environmental threats, are discussed next.

6.3.2 Main theme 2: Planning for the management of unpredictable potential environmental threats

The findings of the second main theme are discussed based on the literature that was reviewed. The second main theme refers to planning for the management of unpredictable potential environmental threats as this will enable local governments to be better prepared for and respond more effectively when these events do occur.

6.3.2.1 Sub-theme: Impact of climate change on local government

Climate change will affect future scenario planning, and it would be advisable to plan for a certain degree of surety that water will be available during extended droughts and that a backup plan exists, should the primary water source no longer deliver water in such communities. It would be considered fruitless expenditure to develop social nodes in areas that are sparsely populated and do not have water security in the context of climate change to guarantee their sustainability and development. The researcher believes this to be found primarily in arid regions such as the Eastern Cape, Northern Cape and North West Province.

There is concern about the extent of the effect that climate change would have on current municipalities in the country's more arid western inland regions (Mcsweeney & Timperley, 2018: 23). It is estimated that by 2050, the average temperature in the country's arid region may have risen by 2°C. The minimum winter temperatures are expected to increase by 3°C on average (Van Niekerk et al., 2009: 2). Especially since agriculture is currently the biggest consumer of water, the average temperature change will limit livestock farming and agricultural practices. What can be cultivated and how much water will be available for such agricultural practices will play a role in the sustainability of the practices in areas adversely affected by climate change.

Therefore, urban food and water security are closely related to future spatial design. Any future land use should be based on sustainable and assured use of water. Decisions made on a whim will affect millions of people in the future. Especially the agricultural sector, which uses 62% of the total available water resource annually (Department of Science and Technology, 2010: 28), is expected to experience drastic changes soon. The Sunday River System and the Eastern Cape Great Fish River System are prime examples of high water abstraction undertaken for irrigation purposes (CSIR, 2010: 35). Sustained agriculture ensuring food security will have to be re-evaluated. The farming and economic sectors are directly affected by abstraction pressures to satisfy rural needs and needs for irrigated

agriculture, especially in arid and semi-arid areas by diminishing water availability owing to climate change.

While groundwater is scarce because of the country's geology and broad porous aquifers exist in only a few places, it is often the primary water source in rural and arid regions as well as in many cities (DWA, 2013:25). The use of groundwater for human consumption is expected to increase further, especially in the western part of the country, which lacks perennial rivers (Food and Agriculture Organisation of the United Nations, 2016: 4).

Groundwater is the primary source of a secure, safe supply of drinking water in rural areas and several towns in South Africa, for the irrigation of thousands of hectares of fertile arable land in the country and for supporting significant numbers of livestock and wildlife. Many mines and factories depend on groundwater (DWA, 2013: 25). Groundwater is, in many instances, the only source of water for rural people across South Africa (Tapela, 2012: 60). Some literature indicates that pumping groundwater is about seven times more energy-intensive than surface water abstraction. However, surface water usually requires much more (energy-intensive) treatment before use than groundwater (United Nations, 2018: 173). Although groundwater is often used for irrigation and rural communities in terms of potable water, the risk is that if abstraction is not controlled and regulated, it can have adverse effects on agriculture, economic development and the sustainability or rural communities. In the opinion of the researcher, in cases where illegal abstraction of ground and surface water is taking place, such practices should be stopped, as they become detrimental to man, wildlife and eventually the environment.

The impacts of climate change are expected to be complex and wide-ranging and so are the security threats related to them. As argued in the IPCC's Fifth Assessment Report, climate change will progressively endanger human life. Climate change is also expected to lead to factors that raise the likelihood of armed conflict, to affect critical transport, water and energy infrastructure, and gradually to define the input to augment national security policies (Mobjörk & Smith, 2017: 2). It is a fact that droughts and floods are part of Southern Africa's climate cycle, and with intensified climate change, droughts and floods rise in frequency and severity. To resolve this complexity, an integrated approach to water supply planning and management is required. Skills development, infrastructure development and maintenance are required to bolster the country's ability to manage future disasters (Muller et al., 2018: 5).

Because of the rate at which the population has grown, the risk is that during an extended drought, the buffer that should be available to supply water to communities will no longer be sufficient. Dams have dried up during the current drought and towns have become stranded and, in some cases, have had to fend for themselves to get water through alternative

means, as local municipalities have not been able to put plans and processes in place to mitigate the effects of the drought ahead of Day Zero. In many cases, the municipalities failed their people. Makhanda (Staff Writer, 2019a), Beaufort West (Payne, 2019) and Graaff Reinet (EWN Reporter, 2019) are but a few examples of towns where the water supply dried up and the dreaded Day Zero happened, a previously unheard-of scenario.

Stats SA indicated in a report, *Poverty Trends in South Africa, an examination of absolute poverty between 2006 and 2015*, that more than half of the South African population lives under the poverty line, facing the threat of climate change, extreme temperatures and the effects these may have on human health (Gambade, 2019).

Poverty and the consequences of climate change represent what local governments should take into consideration when they address the problems of climate change, food security and the impact of extreme events such as droughts and floods. South Africa must plan for and implement such plans. The displacement of communities due to such extreme events can lead to severe socio-economic disruptions, negative health impacts and increased human suffering (Van Niekerk et al., 2009: 19; Welborn, 2018: 13).

Another factor local government should consider is population growth and population density. Population size matters when mitigating any climate change impact on society. Huge and fast-growing populations in Africa, for example, place an immense burden on environmental systems and exacerbate the adverse effects of climate change, such as challenges related to the availability of clean water, food shortages and waterborne diseases due to the total absence or reduced water flow. IPCC research has found that overpopulation is a significant stressor in Africa's water quality and supply, and in certain places has done more harm to water security than climate change (Welborn, 2018: 17).

Gauteng’s per capita water use is too high and should be reduced in the immediate and long term. This idea can be extrapolated and applied to all municipalities to reduce physical losses from their distribution systems, as well as unauthorised use that is not paid for. Social institutions and businesses should reduce their water consumption by introducing efficiency measures, and many households must also be encouraged to reduce their water use. Water user behaviour modification will become common until it has become part of people’s culture and the way they are living. Similarly, modifying water consumption habits will be similar to adjusting one’s lifestyle to load shedding in response to restricted electricity generating capacity by Eskom. All water users must be prepared for restrictions at times of drought, while urban planning must drive towards water-efficient cities.

Adequate, reliable water supply has become critical to the needs of the country. Most municipalities depend almost entirely on an interconnected network of rivers, lakes, canals

and pipelines to provide adequate water. The researcher agrees with Muller et al. (2018: ii) that, where possible, the water mix for consumers must be diversified across municipalities. Groundwater, wastewater reuse, acid mine drainage and rainwater collection are alternative water sources that can enhance water security in all municipalities (Muller et al., 2018: ii). The caveat is that all these sources must comply with the minimum requirements for water standards. Potable water must be free from pathogens, endocrine disruptors and heavy metals. Water standards must be enforced, and non-compliance must bear consequences for municipalities, as climate change will have an impact on the quantity and availability of water.

As part of his latest plan to sweep clean and continue anew, President C.R. Ramaphosa should take this opportunity to make climate change one of South Africa's core economic policy pillars. The primary goal of any truly modern economy is the cultivation of sustained economic growth based on a healthy environment and society. Other African countries, such as Rwanda and Ethiopia, emphasise ecosystem restoration and understand the significance of what they are trying to achieve and it is time for South Africa to follow suit (Le Page, Davies & Hamilton, 2019). South Africa’s policies should acknowledge the need for decarbonisation.

South Africa was one of the founding signatories to the Paris Agreement. When it comes to implementation, South Africa is lagging far behind its aspirations (Le Page, Davies & Hamilton, 2019). To date, South Africa has not drafted any plans or implemented any action plans coupled to target dates and outcomes to reduce carbon emissions. It is a fact that South Africa plays a leading role on the African continent. In the eyes of the world and considering the impact climate change will have on Africa, South Africa stands to suffer more than economic stagnation, food insecurity and water insecurity, as climate change will also affect the ability of the poor to survive.

The poor will be hardest hit by climate change. With unemployment steadily increasing past 29.1% (Stats SA, 2019b: 8), the green economy will be an opportunity for people to obtain a qualification and earn an income. The alternative is higher unemployment, food shortages and displaced communities on a large scale. In other parts of Africa, such as Lake Chad and Niger, where this exact scenario is playing out, poverty escalated, human trafficking increased and crime became a source of income (UN Office for Humanitarian Affairs, 2020). Similarly, the researcher is of the opinion that comparisons can be drawn with South Africa mid COVID-19 lockdown, where poverty escalated and crime (dealing in illegal alcohol and cigarettes) became a source of income. This trend manifested overnight during lockdown.

6.3.2.2 Sub-theme: Early warning and disaster management at local government level

In broad terms, climate change is taking place across the globe because of man's greed to make money, with total disregard of the effect of deforestation and the burning of fossil fuels on the climate and the ecology on which human beings are fully dependent to maintain their way of life across the globe. In short, man is responsible for the effects of climate change. The impact of climate change is the result of this total disregard and therefore not man-made, but is discussed under this main theme, as the world must plan for and mitigate the consequences of climate change.

There is strong understanding, supported by empirical research that the problems the world faces in terms of the effects of climate change, sustainable development and risk associated with disasters need to be tackled in an integrated way (Van Niekerk et al., 2009: 41). Within the South African local government mandate, this integration must be achieved through medium- to long-term municipal development planning.

The problem of water and food insecurity and how well this is mitigated can be traced to the management of the risks and the detail and efficacy of plans that were developed. This has to be done well in advance to deal with these occurrences before they become a problem. In other words, early warning can facilitate the implementation of programmes that can mitigate the effects of climate change. It is perceived that one cannot predict with high accuracy when and how severe future floods and droughts may occur, though better infrastructural planning and improved government coordination can protect communities living in affected areas (Le Page, Davies & Hamilton, 2019).

In the wake of Cyclone Idai and the visible effects in KwaZulu-Natal, the voices of critics were silenced and there were frequent laments about the underfunding of emergency response services and the inadequate ability of municipalities to cope with unforeseen problems. There is a clear argument for the government to step away from conventional reliance on post-impact intervention, recovery and restoration initiatives (Butler, 2019). A more comprehensive and constructive strategy could reduce the risks of climate disasters through prior planning and mitigation measures (Butler, 2019). Disaster risk management must be based on an appropriate organisational plan and structure to ensure that all population segments are involved (Rahman, 2002, as cited in Wentink & Van Niekerk, 2017: 2). Communities should collaborate with local governments to reduce risks (Shaw, Matsuoka & Tsunozaki 2010: 10; UNISDR, 2010: 3, as cited in Wentink & Van Niekerk, 2017: 2). This means that policymakers must include the community in the disaster risk management plan to ensure that the community buys into the project and the processes that will follow (UNISDR

2004a: 4; Pelling 2007; Pribadi & Mariany, Kemp 2008: 99, as cited in Wentink & Van Niekerk, 2017: 2). Proactive drought management is not seen as a priority in South Africa. It became evident in the literature that if all three tiers of government responded to the plight of towns and farmers, the management of drought could become much more proactive (Muller et al., 2018: 34).

Agri SA called on the government to take urgent measures to alleviate the effects of drought and other climate change events, including a National Drought Management Commission, private-public partnerships, multi-risk agricultural insurance and the implementation of an early warning system programme. Such programmes have been implemented successfully in other countries (Moubray, 2019). Given the need for frameworks and resources for disaster risk management both in legislation and in regulation, it is a role that is crucial in times of need but is often under-funded and ignored. Similarly, research has found that most local governments fail to take responsibility for climate change mitigation and adaptation initiatives, resulting in paralysis in the government structures that should take action (Van Niekerk et al., 2009: 42). ~~District and local municipalities must take disaster risk management seriously and show commitment through a proper budget and skills allocation.~~

At the heart of water provisioning lies research, which in turn should inform policy and decision-making on the future of water management as a function of government and water resources in South Africa. The Water Research Commission, Department of Science and Technology and the DHSW&S (then still DWS), after wide consultation with various role players in the water industry during 2016/17, including consumers, prepared an RDI roadmap focusing on unlocking alternative water sources by examining supply and demand governance, as well as management and planning of water resources. This roadmap further discusses possibilities for exploring innovative methods of handling built and natural infrastructure, enhancing the water sector's market performance by dealing with NRW and driving innovation in pricing, metering and billing of water (Annual Report WRC, 2017: 26). The total implementation in 2015 financial terms was R 8.4 billion over ten years (NW&SMP, 2018: 14-4). It is evident that without scientific research, any decision about the future of water management and peripheral matters relating to water management would be baseless, with no sound research conducted to support why certain decisions were taken.

It is foreseen that the 4IR will facilitate the collection of data to use in models at local government level to expedite forecasting and early warning. Climate change will continue to present some risks to South Africa’s water resources. According to the CSIR (2019: 54), the Green Book should be able to examine the effects of climate change on ground and surface water and translate results into risks affecting urban water supply at local government level.

For local governments to exploit such a technologically advanced system in better forecasting and planning, the key lies in trained human capital to manage the technology. It is foreseen that, despite funds and skills growth in this sector, this awareness will assist all three tiers of government to do disaster planning. The researcher believes that this ability should also be applied to neighbouring countries for their planning and forecasting capability.

To conclude, the second main theme, which referred to planning for the management of unpredictable potential environmental threats as this will enable local governments to be better prepared for and respond more effectively when these events do occur was discussed under the following two sub-themes:

- The impact of climate change on local government, and
- Early warning and disaster management at local government (district and local municipalities).

In conclusion, the findings in this study were divided into two main themes. The first main theme referred to human factors threatening water security that should be managed through continued intervention at local government. The second main theme referred to planning for the management of unpredictable potential environmental threats. Based on the above findings, recommendations are made in the following section to mitigate and address the results, under the same headings and subheadings.

6.4 RECOMMENDATIONS

An analysis of the findings of the main theme of human factors threatening water security that should be managed through continued intervention at local government level resulted in the following recommendations:

6.4.1 Main Theme 1: Human factors threatening water security to be managed through continued intervention at local government level

6.4.1.1 Sub-theme: Fiscal management

To address the funding and maintenance of existing infrastructure, the building of new infrastructure, and revenue collection, the following recommendations are made:

- All three tiers of government are cash-strapped, and the DHSW&S is but one of many state departments that are annually competing with other state departments for budget allocation. It is suggested that in a cascading manner, local government should do a cost analysis for the short term (three-year outlook), medium term (five-year outlook) and long term (ten-plus year outlook) to determine which water infrastructure projects must be planned and budgeted for, in terms of actual cost coupled to the rise in inflation. This must be rolled up to the national government and where necessary incorporated in the NDP. The purpose of this would be to establish a sense of the magnitude of the fiscal shortfall. This will also give the local government an indication of which projects can be funded by the DHSW&S and which projects must be funded through other means, e.g. public-private partnerships, private sector investment or municipal taxes, the collection of outstanding municipal debt and issuing of fines. Collected revenue should be ringfenced for water infrastructure projects and not utilised for other emergencies.
- Local government should guard against deferring maintenance of existing water infrastructure or the development of new infrastructure projects. If it is going to be costly now, it will be even more expensive by the time a crisis such as a drought looms or when the water in the reservoirs has already dried up. Moreover, any remedial steps that might be taken when the reservoirs have dried up might be futile, as the opportunity to mitigate or even prevent a disaster would have passed. It is a known fact that when a project is postponed, it will be more costly to complete in future. It is highly likely that if funding is not allocated immediately or is ringfenced, other priorities will manifest and absorb the funds. This will result in water infrastructure projects being postponed to subsequent financial years until they are totally unaffordable or too late to have a positive impact.
- More municipalities, including those without acute water stress, should adopt more competitive tiered pricing tariffs for rich people consuming large quantities of water for their

landscaped, manicured gardens and swimming pools. Tiered pricing, which is imposed when water is mostly free for basic human needs, but allows regulating of additional water beyond what is required to live, might have to become compulsory, especially since climate change projections and population growth indicate that water will become even more scarce in the future. It will become a case of survival for all with the amount of water that is still available.

6.4.1.2 Sub-theme: Managerial and leadership capacity at local government

With regard to managerial oversight and leadership development, the following recommendations are made:

- Post requirements for placement and staffing purposes should either be revised or enforced when appointments are made. Only individuals who comply with the post requirements formulated for each post must be appointed in that post. That will ensure that post incumbents are qualified to perform their duties successfully.
- The value of assessment centres in leadership and decision-making development of existing managers or new appointees should not be underestimated. All managers and appointees in leadership positions should regularly be evaluated and given guidance in terms of problem-solving capabilities and other areas of development. If this is done, a competent workforce should emerge over time. Simply having a degree does not imply that a manager has good leadership qualities or exhibits managerial proficiency when called upon. Assessment centres should not be confused with performance assessments. Performance assessments can become a tool to give feedback to a manager or a leader in terms of how well they scored or attained deliverables that are generally agreed upon at the beginning of each year. Assessment centres are more focused on skills development and honing certain traits or qualities that have been earmarked as key attributes to fulfil a position successfully. These key attributes that an incumbent must master or exhibit are usually specified in the post profile of each position. By regularly assessing young and upcoming managers, their development can be measured and tracked over time, and they can be groomed for certain key positions. In that way, employees are set up for success rather than failure.
- Consequence management comes from the top. From the President of South Africa to the Minister of the DHSW&S to mayors and municipal managers, people take their cues from the top. If the top management sets the example that poor governance and corruption have no consequences, people will continue exercising poor judgement and exhibit total disregard for good governance (Prinsloo & Roos, 2006: 86ff, 100ff, 108ff).

- Poor governance and non-compliance with policy and legislation are linked to consequence management. If there is consequence management from the very top of any organisation, employees will follow the rules. Makwetu (2019b: 4) reported that officials at local government level act with impunity, as there is very often no consequence management for poor discipline and non-delivery of work (Roos & Stainbank, 2017: 125ff).
- M&E must become the gold standard by which performance is measured. Again, M&E must be implemented right at the top of every structure and cascade down to the lowest level. The information obtained in this fashion must be used to adapt plans and take corrective action where needed to get programmes and projects back within target parameters. Progress must always be monitored. In this way, excellent performance can be rewarded, and steps can be taken to mitigate poor performance based on valid and accurate data.

6.4.1.3 Sub-theme: Skills shortages in the water industry and building human capital for the future

Skills shortages in the water industry have been widely reported, as mentioned earlier. To address these shortages, the following recommendations are made:

- To be able to address the skills shortage in the water industry in South Africa, targeted recruitment should be considered, with bursaries for prospective students being awarded at school level. Career progression should be afforded to those candidates who have reached the top of their grades internally within all three tiers of government pertaining to water management. Scarce skills can thus be retained, and individuals with a technical background who have managerial capabilities and aspirations can be afforded the opportunity to get the necessary exposure to become good managers and experts in their fields.
- Students must be given bursaries to study in the following fields in which people with relevant qualifications are in short supply: analytic chemistry, aquatic sciences, biochemistry, biological sciences, water and sanitation, geographical information systems, civil/electrical/mechanical engineering, water resource management, environmental law/management/science, water utilisation, cartography, geochemistry, geohydrology, geology, hydrology, limnology, microbiology, surveying and water care (South Africa, 2017: 13).
- Targeted recruitment should also focus on the skills required to stay abreast of developments in water management and 4IR.
- Small-water and wastewater occupations are mentioned in the Organising Framework for Occupation, as these workplace training programmes are not standardised and represent

specific needs/gaps. This tendency leads to misprioritisation and redistribution of project resources. Workplace skills plans should, therefore, be standardised uniformly across the industry.

- Where incumbents should have a specific background or qualification, vacancies should be dealt with appropriately. Targeted recruitment of people with scarce skills will require a special remuneration dispensation that will make it hard to resist an offer from the DHSW&S or local government.
- Targeted recruitment or a unique home-grown initiative should be launched to facilitate drought management. Applicants will have to have a background in supply management, demand management and conflict resolution, as well as drought monitoring (Muller et al., 2018: 34).
- Opportunities for upskilling or even reskilling to retain good workers will have to become the norm at all three tiers of government, not only local government, especially as new job opportunities will arise as the government moves towards a green economy.

6.4.1.4 Sub-theme: Non-revenue water, infrastructure development, planning and maintenance

Infrastructure must be maintained, or planning must be done in time for new infrastructure development. Therefore, the following recommendations are made:

- Municipalities must reinstate the M&E of water losses. Only by monitoring NRW will municipalities know how much water is lost in the water reticulation system so that corrective measures can be implemented in terms of maintenance and repairs. Failure to monitor water losses implies not only a financial loss in terms of revenue collection for a municipality, but also wasted water that is lost, which is ill affordable during times of drought, or a spike in water needs driven by population growth.
- Municipalities should do scenario planning in terms of the impact of climate change on sustainable water supply. This is especially true of arid parts of the country where surface water must be augmented by abstraction from groundwater. Sustainability of groundwater comes under threat owing to over-abstraction and should, therefore, be controlled, monitored and regulated. The key to success would be to have plans in place for access to alternative sources of water, should the regular supply of water become compromised for whatever reason.
- Planning should include ways and means to promote groundwater resource drought-proofing. Planning should also earmark water-insecure areas and communities and prioritise water-related relief initiatives for domestic and production needs. Developing

maps of available groundwater resources will provide valuable support for future planning (Calow et al., 2010: 255).

- Management of stormwater, which should be given greater consideration in new and established settlements, is equally essential for water provisioning. The aim is to ensure that stormwater management is established in low-income areas to mitigate risk to life, health, and property. Stormwater drainage schemes must be maintained in all municipalities and these municipalities should ensure that adequate resources are allocated to maintain the stormwater infrastructure (Muller et al., 2018: 42).

6.4.1.5 Sub-theme: Water provisioning, prevention of pollution and water standards

To facilitate water provisioning, implement preventative action pertaining to pollution and secure sources of water for use by local government, the following recommendations are made:

- The building of the Polihali Dam as part of the second phase of the LHWP will go a long way in ensuring water security to Gauteng, the economic hub of South Africa. This project is behind schedule and should receive the necessary attention to bring it back on track. Apart from the involvement of the DHSW&S, the intervention of the Department of International Relations and Cooperation might also be required to smooth relations with Lesotho. The sooner this project is brought back to life the better, as demand in Gauteng will outstrip supply by 2025.
- The DHSW&S should enter into discussions with Lesotho to amend the treaty provisions to maximise the yield of the IVRS and to minimise unnecessary water losses through evaporation at low altitudes when the receiving dams are full during high rainfall years. In this way, expensive water obtained in terms of the treaty is not released unnecessarily, so that water is released only when required, and Lesotho is appropriately compensated. Conservation of water should be key (Muller et al., 2018: 21).
- Municipalities that allow raw sewage to pollute rivers should be fined. Litigation should be instituted against the municipal manager and the mayor. The moment this happens, a message will be sent to all other municipalities. It is predicted that measures will be taken to repair and maintain broken wastewater facilities across South Africa to prevent similar punitive action being taken against transgressors. Because no consequence management takes place, no attention is paid to untreated wastewater polluting rivers and streams.
- More stringent and harsher measures to discourage and prevent pollution should be introduced. Serious consideration must be given to the introduction of administrative penalties. At present, the court system is the only means of imposing penalties on

individuals or businesses that are breaking the law. This approach will allow the DHSW&S and/or CMAs to impose significant fines on those using water illegally, discharging wastewater unlawfully, or otherwise violating the law. To serve as a deterrent, the penalties must be concomitant with the seriousness of water-related crime and relative to the potential impact on or damage to human and ecological health (NW&SMP, 2018a: 6-3).

- Wastewater re-use after cleaning should become the norm in South Africa. There are a few examples of cleaned wastewater being re-used. This practice should be used to augment existing water provisioning to municipalities. The Beaufort West wastewater plant treats sewage to a point where it is clean enough to drink. It is the only such plant in the country (Ritchie, 2018). Cognisance should be taken of the type of effluent concentrations or types of pollutants that disrupt the treatment processes of wastewater received and could render it unsuitable for treatment for re-use (NW&SMP, 2018a: 5-11).
- Minimum criteria for wastewater treatment works must be drawn up, designed to meet the operating cost requirements that match the economic strength of the towns/cities to which a service is rendered (NW&SMP, 2018a: 5-20).
- Programmes will have to be developed, targeting business and domestic consumers to change their water use habits and to conserve water. This should primarily be aimed at schools and teaching and learning institutions so that South Africa can raise a new generation that is water conservation conscious.
- Rainwater harvesting to augment domestic use should be encouraged. This can become a useful behavioural change agent aimed at schools, where the principles of sound water management and use should be integrated into teaching and learning (Muller et al., 2018: 41).
- As a matter of urgency, the DHSW&S will have to decide how many CMAs will be established, funded and implemented so that the CMAs can do their work as foreseen.
- The securing of strategic water source areas should be investigated to ensure these areas remain pristine and are not affected in any way. These “comprise only 10% of the land area, but deliver 50% of surface water, supporting half the population and nearly two-thirds of the economy” (Walters, 2019). It makes strategic sense to put governance in place to ensure that these strategic water resource areas are protected and that hefty fines are imposed when these areas are affected by individuals or corporates.

6.4.2 Main Theme 2: Planning for the management of unpredictable potential environmental threats

An analysis of the findings of the second main theme on factors related to the planning for the management of unpredictable potential environmental threats, is discussed next.

6.4.2.1 Sub-theme: Impact of climate change on local government

To address the effect and to mitigate the impact of climate change on local government, the following recommendations are made:

- Domestic and regional security agencies and military forces with a footprint in Africa should promote comprehensive policies, initiatives and investments in climate adaptation initiatives as part of the African Union, in particular concerning the impact of climate on water and food security and its related effects on stability, conflict and displacement on the continent. This should become visible in their primary mission sets and commitments (The 2020 World Climate and Security Report, 2020: 6). It is foreseen that from 2030 onwards African defence forces will become increasingly involved with humanitarian aid and relief missions in response to the effects of climate change.
- An ambitious climate mitigation strategy comparable to the Millennium Development Goals, with the cooperation of corporate leaders in the economy, environmentalists, academics in the sector and representatives from the government, should be developed. (The 2020 World Climate and Security Report, 2020: 6). It is also advocated that such a plan must be coupled to target dates with measurable outcomes that must be monitored and reported on, as time is running out for the government to obtain buy-in from the private sector and captains of industry at local government, as well as the provincial and national government. As 2030 is a mere ten years from now, such a plan for South Africa and the commitment of resources to prevent a possible disaster from taking place should become a priority of the DHSW&S in conjunction with the DEA and the DA as the environment and agriculture are key role players in such a venture. It should be reported on regularly at parliamentary level. Lessons should be learnt from what happened in Syria and Libya and the current living conditions in these countries. The severe drought in Syria in 2007-2010, which was most likely caused by climate change, eventually led to the displacement of more than 1,5 million people before a raging civil war erupted (The 2020 World Climate and Security Report, 2020: 56).
- Such a climate mitigation plan should focus on water security and food security, as these will come under threat as climate change takes effect owing to an increase in temperature in the region. Drought-proofing of South Africa’s water and food resources should be put on the climate mitigation agenda as a conflict prevention tool. Preparedness for South

Africa should be aimed at climate resilience opportunities, such as ensuring water security, food security and disaster preparedness, as these challenges will become a reality from 2030 onwards (The 2020 World Climate and Security Report, 2020: 6). Any proposals to address food and water security in the next ten years will address issues of state-wide stability maintenance, conflict resolution during disasters and inter- and intrastate population displacements arising from climate change. It is expected that the impact of climate change on water security from 2030 onwards will pose substantial threats to global security (The 2020 World Climate and Security Report, 2020: 7). Foresight, planning and execution of viable initiatives should replace hindsight.

- The opportunity to develop and get involved in the green economy will create job opportunities. Local government must embrace this opportunity with open arms to create job security and career progression opportunities.
- South Africa will increasingly move away from coal-fired power plants to less water-intensive sources of sustainable energy at national level. The Medupi and Kusile power stations will gradually achieve optimum output in producing electricity. This capacity rests on the assumption that sufficient water will always be available for their operation. Both power plants will need significant volumes of water when they are operating at full efficiency. Each power station will consume no less than 26 million m^3 of water per year (Overy, 2020). As water will in future come under increasing stress as climate change takes effect, South Africa will have to explore clean energy as an alternative to fossil fuel power stations. Water provisioning in times of drought can become problematic for municipalities in the immediate geographical proximity of such fossil fuel power stations, as competition to gain access to water will ensue.
- Innovation in wastewater treatment systems, groundwater mining, treating acid mine drainage and rainwater storage are all potential water supply options when the effects of climate change become visible (Gleick & Iceland, 2018: 9). Reuse of wastewater may incentivise better wastewater management, as it would yield obvious benefits in the form of usable water (Muller et al., 2018: 42).
- Desalination on a mega-scale can assist in augmenting water supply and can even be used to augment water for irrigation and agriculture. If fuel can be pumped to Gauteng from Durban, the opinion is held that water can also be pumped to Gauteng and other provinces. Economies of scale will bring the price per cubic metre of water down.
- The desalination cost will be high but must be opposed to the alternative to having no water at all:
    - Increased food insecurity.
    - Power outages as coal-fired power plants use massive amounts of water.

- A failed economy in Gauteng and other provinces, as no new economic hubs and town planning will be possible without water.
- Limited health care and education, as existing infrastructure will not have sufficient access to water, and it will be impossible to build new infrastructure such as hospitals and schools; the population will consequently have to be accommodated elsewhere. Such a situation will create further unemployment and other social ills associated with a higher unemployment rate.

- Agriculture will be affected by climate change. Agriculture and livestock farming, especially in arid parts of the country, will be affected by climate change, and therefore, farming practices will have to adapt to conserve water. This can be done through drip irrigation and change crop cultivation that is more suitable for arid climates. Sustainable agriculture will ensure food security.

6.4.2.2 Sub-theme: Early warning and disaster management at local government level

Several role players have indicated the necessity of early warning of disasters and the management of events before they take place, as well as planning for what must be done by whom after the event, to improve the efficacy of efforts to effect change in this environment. The following recommendations are made:

- Disaster risk management must be developed in an integrated manner. All possible role players should be involved from the beginning. Funding must be made available to disaster management structures at local government level. Research has found that most government structures do not see climate change mitigation and adaptation as their responsibility (Van Niekerk et al., 2009: 41). It is suggested that SALGA play a leading role in making sure that this crucial capability is funded and given access to research capabilities to assist disaster management structures to function better.
- Unique contextualised policies aimed at provincial and local government must be developed and combined with the Growth and Development Strategy, the Spatial Development Framework and the Integrated Development Plan in order to understand existing and potential future risks posed by climate change. These strategies and proposals should inform approaches to disaster risk reduction strategies to deal with the effects of climate change.
- Local government, in conjunction with SALGA and CoGTA, should look at the 4IR to develop an early warning capability, which will go a long way in ensuring adequate response in time to serve communities better.

- SALGA should commission a drought management M&E plan, as drought management must take place in various areas, e.g. technical expertise and political assistance, public engagement and legal expertise to deal with ramifications through various state structures. The rules of resource allocation and restriction/rationing, including public participation of the affected communities, should be established before droughts occur and agreed upon before extreme events occur (Muller et al., 2018: 34).
- District and local municipalities must take disaster risk management seriously and show commitment through an adequate budget and skills allocation (Wentink & Van Niekerk, 2017: 9).
- At the heart of water provisioning lies research, which in turn should inform policy and decision-making on the future of water management in South Africa at local government level. The RDI roadmap is the ideal vehicle to research water provisioning, conservation, pollution, governance and new technology. Therefore, it would be prudent of the government to find the money that is required to fund the RDI.
- Green Drop assessment reports, which were terminated in 2014, should be reinstituted to monitor water quality and compliance with water standards as a matter of urgency.
- The Green Book that was developed by the CSIR will enable local governments to analyse the impact of climate change on ground and surface water better and translate the data into the risks that municipalities will face in providing water. It should be made available to all local government structures across South Africa.
- The Green Book capability should also be rolled out to neighbouring countries to assist in their planning and forecasting capabilities, as climate change will affect the whole Southern African region.

This concludes the findings and recommendations that were made based on the two main themes and subsequent sub themes that were identified and discussed in detail in this chapter. Concluding remarks pertaining to the study and recommendations for future research will be discussed next.

6.5 CONCLUSION

South Africa's water security and water management problems, which are multi-faceted, will require dedication, resources in terms of human capital development, dedicated budgetary allocations, and ultimately, management and leadership skills to deal with the problem. In the literature, it has become evident that this problem has quietly been building momentum. If water management continues along the current trajectory, it will become virtually impossible to draw back from the abyss after years of neglect and mismanagement. The irony of this statement is that typically, when catastrophic consequences do occur, money is found and made available either to address the problem or to delay its reoccurrence. A case in point is the money that was made available to address the COVID-19 crisis in South Africa.

The dilemma South Africa is facing at present is an unpleasant reality. In terms of nation-building, addressing poverty and unemployment are the top priorities of the development agenda, with vast amounts of funding in the fiscus being channelled to address these pressing matters. Very little is consequently available for unplanned emergency projects, should disaster strike. This implies that at present, there is only so much money available for infrastructure development and maintenance. Without water, there can be no economic development and infrastructure development and no economic growth. The case of Somalia has been presented, where it was found that a drought can lead to a failed state scenario (Reuters, 2018).

South Africa's service delivery record of late indicates that on a broader scale, the country is not rendering effective and efficient municipal services to all the people in all municipalities, all the time. A few municipalities do manage to get this right, but the majority fall short of the target, and some have become entirely dysfunctional. It would appear that at the municipal level in South Africa there is a battle to get the basics right and a loss of strategic direction. In business, the basics must be in place so that there is a sound base from which to build the future. If South Africa at municipal level is unable to deal with fundamentals such as essential services, e.g. clean water and sanitation, maintenance and repair of existing infrastructure under normal circumstances, this begs the question: How is the country to effect higher-order changes in society at large in the way people live that will ensure the survival of South Africa as a nation on the continent, under abnormal circumstances such as droughts and famine?

Most ordinary South Africans have been rudely awakened over the last few years to the reality that South Africa is a water-scarce nation, plagued or distressed by intermittent droughts. While the authorities have been able to transfer water from catchments with a surplus to areas with a deficit for many years to maintain the idea of water abundance, the

reality is that the effects of poor management practices have been running their course. South Africa is at the cusp of feeling the consequences of municipalities that have been mismanaged for years. There is not enough water left in the system to redistribute if it is decided to continue using it as it was used before. The situation requires the leveraging of technologies to supplement water supplies, reduce usage and manage and deliver piped water more efficiently (NSDF Draft, 2019: 54).

In the last century the emphasis was on the engineered system, the part people can design and manage. Water security in this century will depend on the ability to manage growth in a manner consistent with ecological infrastructure. It will limit the causes that diminish the ability of nature to provide people with water (WWF-SA, 2013: 7). It is necessary to identify and prioritise the shortcomings of the country's natural water resources if a sustainable economy is to be built that meets the needs and aspirations of all those living in South Africa (WWF-SA, 2013: 7).

Effective institutions are essential to keep the system running, with the emphasis on the term effective. Water security is threatened by institutional weakness and possible failure at all levels. There are severe shortcomings in the management of water resources across South Africa. For example, the ongoing Emfuleni sewage spillage saga has been reported to various role players in the water industry at all three tiers of government, with no effect. This points at operational problems that reveal lack of contingency planning, while the many challenges faced by municipalities similar to Emfuleni are well documented.

From the very top of government, a poor example is set, since no management oversight of remedial action takes place and no steps are taken to institute legal action where this is indicated. In other words, there is total disregard for consequence management when employees at local government level ignore authority and principles. Not making an example of people who do not abide by the rules and overstep the boundaries stipulated by law allows the slow onset of institutional failure, which is without a doubt putting the future of the country at risk. Almost all homes, businesses, factories and public establishments (hospitals, schools, etc.) depend on the ability of municipalities to supply South Africans with water. The South African Constitution mandates municipalities to provide citizens with clean water that is free of pathogens, to render sanitation services to all citizens and to function in a financially sustainable manner.

This includes maintaining comprehensive infrastructure networks and related technological and financial accounting systems. The national and provincial government must fund and regulate municipalities to provide water and sanitation services (Muller et al., 2018: ii). Based on this study, it can be argued that the national and provincial governments are

frequently not doing their jobs, and if they are doing their jobs, in many instances they are not doing it well enough.

Should the tendency identified by the AG SA's Mr Makwetu over the past three years continue, namely that every year more and more municipalities fall into disrepair and that the governing party is not prepared to take hard decisions to rectify this behaviour, South Africa would risk causing undue hardship and suffering to the masses when the taps run dry or water becomes unfit for human consumption. Climate change will undoubtedly change the way of looking at water in the near future.

Water security and planning to ensure water security have not received the attention these matters deserve from all three tiers government. This should be investigated urgently, as time to rectify this problem is running out.

The people of South Africa deserve to feel safe from fear or want, as enshrined in the Constitution. Water is key to stability, growth and prosperity. This resource should be treated as such.

6.6 RECOMMENDATIONS FOR FUTURE RESEARCH

The following are recommendations to consider for future research:

- It is necessary to determine what comprehensive measures, inclusive of funding and infrastructure development, as well as the role that technology can play, must be employed to ensure that South Africa is water-secure beyond 2030.
- Based on available data on the topic of climate change, an assessment must be made of which parts of the country will most likely be affected negatively by climate change and what action plans or workable options should be formulated for implementation of relief action to those communities. It should be clear at what point (worst case scenario) relocation of entire communities will be considered as an option, where they will be accommodated in such a case and at whose expense this will be done.
- It must be determined how desalination on a mega-scale can assist in augmenting water supply and even be used for wastewater treatment to augment water for irrigation of agriculture, since after 2025, water supply will no longer meet demand.
- The measures to be employed to return wastewater for re-use must be clearly stipulated, as well as the circumstances under which this technology can be used and the criteria to be adhered to, as it is still cheaper than desalination.
- Locations where wastewater recycling is most likely to succeed must be identified as this capability is not suitable for all environments. Location, geography, funding, maintenance,

water volume, population density are all factors that should be considered when developing such capabilities.

6.7 STUDY CLOSURE

Public institutions are the cornerstone of the water sector, ranging from catchment management agencies that look after the natural resource to municipal water service providers that make sure there is water in the taps and treat wastewater. However, all businesses and households use water and affect water use and disposal, therefore water is everybody's business (WWF-SA, 2016: 83).

South Africa's major water source networks drive social and economic growth. The available research is unequivocal: the country can definitely not afford to continue misusing its water resources by pursuing a 'business-as-usual' approach. If the authorities wait, South Africa's freshwater resources will be exhausted and unable to meet domestic and industrial demands by 2030 (CSIR, 2010: 64). This will happen even sooner if the effects of climate change occur at an accelerated pace, faster than predicted, or exceed forecasts in terms of their magnitude and severity on the continent. The problems would be compounded by reduced water flow, continued pollution and the guaranteed outbreak of disease due to a reduced thinning effect.

South Africa needs to realise that owing to inappropriate management principles and non-adherence to good governance practices at local government, the country is denying a prosperous and secure future to generations to come, as water is the cornerstone of its way of life. Without water, there can be no future. There is no substitute for water, and yet South Africans treat this resource as if it will always be available in the right quantities, pristine, clean, and ready to drink. Water contaminated with sewage is as bad as no water at all. Soon, climate change will, without a doubt, force South Africans to change the way they use and treat water.

This study has shown that water, as a primary building block of our economy, is not managed and conserved at a level consistent with the manner a scarce resource should be looked after. Cities and towns are the primary economic drivers for local economies in South Africa and are dependent on water supply daily.

Various scholars, in invaluable and insightful papers, have pointed out the need for public service leadership (Latib, 2014: 30ff, as cited in Mulaudzi & Liebenberg, 2017: 47), the growth of public sector managerial leadership (Nkwana, 2014: 85ff, as cited in Mulaudzi & Liebenberg, 2017: 47) and the implementation of effective local government (Madumo, 2014: 131, as cited in Mulaudzi & Liebenberg, 2017: 47). Much time would have to be spent on enhancing ethical leadership, beginning with accountability and transparency. High-quality,

knowledgeable, and responsible leadership preparation and instruction at all levels of government warrant attention. Leaders should be able to interact and to promote social needs to improve policymaking and implementation within the constraints of available resources. More importantly, regaining legitimacy for this or any future government will be of the essence (Mulaudzi & Liebenberg, 2017: 47).

A case has been made in this study that poor water stewardship combined with water scarcity could prove costly to South Africa's economic growth and can thus cause water insecurity to become a threat to national security. Lack of attention to the protection of critical water supply resources and the maintenance of infrastructure can have significant human health implications for all citizens who are protected under the Constitution of SA.

For South Africa to remain a contender on the African continent, the country needs to remain water-secure and food secure. The inverse will bring unimaginable and avoidable hardship.

"*When the well is dry, we will know the worth of water*" - Benjamin Franklin (1706-1790).

REFERENCE LIST

Acemoglu, D. *et al.* (2012) 'A dynamic theory of resource wars', *Quarterly Journal of Economics*, 127(1), pp. 283–331. doi: 10.1093/qje/qjr048.

Agri SA COE (2019) *Agriculture Drought Report 2018/19*. Available at: https://www.agrisa.co.za/download/hr6ar27bjke6g5ikb7y2mneqi6rzjy8wgfpr9kfi.pdf.

AG SA (2018) *Our reputation promise/mission*. Available at: http://www.agsa.co.za/Portals/0/Reports/MFMA/201617/GR/MFMA2016-17_FullReport.pdf.

Alfarra, A. *et al.* (2009) 'A Framework for wastewater reuse in Jordan: From present status to future potential, Applying the wastewater reuse index (WRI) as indicated', p. 134. Available at: http://www.anthonyturton.com/assets/my_documents/my_files/55A_WRI_AA_FV.pdf.

Anike, O.-E. E. (2019) 'Hunger and Anger in the Land: Achieving National Security through Food Security in Nigeria', *Budapest International Research and Critics Institute (BIRCI-Journal) : Humanities and Social Sciences*, 2(3), pp. 7–16. doi: 10.33258/birci.v2i3.388.

Annual Report DWS FY 17/18 (2018) *Annual Report 2017/18 Department of Water and Sanitation*. doi: 10.1053/j.tvir.2012.02.004.

Annual Report WRC (2017) *Annual Report Water Research Commission 2016/17*. Gezina, Pretoria. Available at: www.wrc.org.za.

Annual Report WRC (2018) *Water Research Commission Annual Report 2017/18*. Pretoria: Water Research Commission. Available at: http://www.wrc.org.za/?mdocs-file=50393.

APP DWS (2018) *Annual Performance Plan FY 2018/19 to 2020/21*. Pretoria. Available at: http://www.dwa.gov.za/documents/AnnualReports/FINAL_Inhouse_APP 201819 to 202021 Vote 36.pdf.

Arnoldi, M. (2018) 'DWS notes concerns about War on Leaks programme', *Engineeringnews*, July, pp. 1–15. Available at: http://www.engineeringnews.co.za/article/dws-notes-concerns-about-war-on-leaks-programme-2018-07-10.

Baldwin, D. A. (1997) 'The Concept of Security Revisited', *Review of International Studies*, 19(1993), pp. 5–26. doi: 10.1093/ejil/chl006.

Beishline, J. R. (1963) *Military Management for National Defence*. Englewood Cliffs: Prentice-Hall, Inc.

Bertocci, D. I. (2009) *Leadership in Organisations: There is a Difference between Leaders and Managers*. Lanham, Maryland: University Press of America Inc. doi: 10.1016/1048-9843(95)90027-6.

Bester, P. C. (2019) *Emerging Challenges in Terrorism and Counterterrorism: A National Security Perspective*. The Hague University of Applied Sciences, Faculty of Public Management, Law and Safety 17 January 2019. The Hague.

Bisseker, C. (2017) *Why all of us need to prepare for Day Zero*, *BL Premium*. Available at: https://www.businesslive.co.za/fm/features/2017-08-18-why-all-of-us-need-to-prepare-for-day-zero/ (Accessed: 1 November 2019).

Blanton, S. L. and Kegley, C. W. (2017) *World Politics: Trends and Transformation*. Boston: Cengage Learning.

Bloomberg (2019) 'South Africa's R172 billion free education plan unlikely to deliver skills: World Bank', *Businesstech*, pp. 1–3. Available at: https://businesstech.co.za/news/government/294756/south-africas-r172-billion-free-education-plan-unlikely-to-deliver-skills-world-bank/.

Botha, D. *et al.* (2011) *Disaster Risk Management Status Assessment at Municipalities in South*. Potchefstroom. Available at: file:///C:/Users/Johan/Documents/Biblioteek Fotos/Bronne Internet/Salga_DRM Reseaerch _ReportFINAL_V1_2.pdf.

Brand, R. (2019) *Bailouts to push South Africa's debt ratio above 70 % of GDP*, *IOL News*. Available at: https://www.iol.co.za/business-report/economy/bailouts-to-push-south-africas-debt-ratio-above-70-of-gdp-36321276 (Accessed: 13 December 2019).

Bryman, A. (2012) *Social Research Methods*. 4th edn. Oxford: Oxford University Press.

Burns, N. and Grove, S. K. (1993) *The Practise of Nursing Conduct, Critique & Utilisation*. 2nd edn. Philidelphia: W.B. Saunders Company Harcourt Brace Jovanovich, Inc.

Butler, A. (2019) 'SA's lack of preparation for emergencies is alarming', *BL Premium*, 26 April, pp. 1–4. Available at: https://www.businesslive.co.za/bd/opinion/columnists/2019-04-26-anthony-butler-sas-lack-of-preparation-for-emergencies-is-alarming/.

Calow, R. C. *et al.* (2010) 'Ground Water Security and Drought in Africa: Linking Availability, Access, and Demand', *Ground Water*, 48(2), pp. 246–256. doi: 10.1111/j.1745-6584.2009.00558.x.

Campbell, K. M. and Parthemore, C. (2016) *one National Security and Climate Change in Perspective*. Available at: https://www.brookings.edu/wp-content/uploads/2016/07/climaticcataclysm_chapter.pdf (Accessed: 12 January 2019).

Chow, G. C. (2004) 'Economic reform and growth in China', *Annals of Economics and Finance*. Peking University Press, 5(1), pp. 127–152. Available at: http://down.aefweb.net/AefArticles/aef050107.pdf.

Cilliers, J., Schünemann, J. and Moyer, J. D. (2015) *ISS - Power and Influence in Africa*, *African Futures Paper*. 14. Pretoria. Available at: https://issafrica.org/research/papers/power-and-influence-in-africa-algeria-egypt-ethiopia-nigeria-and-south-africa.

CoGTA (2019) *SA : Minister Nkosazana Dlamini Zuma welcomes Auditor-General municipal audit report*, *Online*. Available at: https://www.polity.org.za/article/sa-minister-nkosazana-dlamini-zuma-welcomes-auditor-general-municipal-audit-report-2019-06-27 (Accessed: 28 June 2019).

Connor, R. *et al.* (2017) *The UN World Water Development Report, 2017: Wastewater: Executive Summary*. Perugia, Italy. Available at: http://unesdoc.unesco.org/images/0024/002475/247552e.pdf.

Conway, D. *et al.* (2015) 'Climate and southern Africa's water-energy-food nexus', *Nature Climate Change*. Nature Publishing Group, 5(9), pp. 837–846. doi: 10.1038/nclimate2735.

CSIR (2010) *A CSIR Perspective on Water in South Africa - 2010*, *CSIR Report No. CSIR/NRE/PW/IR/2011/0012/A*. Edited by S. Oelofse and W. Strydom. Pretoria. doi: 10.1016/j.marpolbul.2012.09.013.

CSIR (2019) 'CSIR Annual Report 2018/19', *Annual Report*, (September), pp. 160–164. Available at: https://www.csir.co.za/sites/default/files/Documents/CSIR ANNUAL REPORT 201819_FINAL LOW RES revised.pdf.

Cupido, D. and Taylor, T. (2019) 'Drought drives Karoo to collapse', *Business Live*, 16 June, p. 4. Available at: https://www.businesslive.co.za/bt/business-and-economy/2019-06-16-drought-drives-karoo-to-collapse/.

Dawood, Z. (2019) *Ethekwini mulls litter traps on CBD's stormwater drains*, *IOL News*. Available at: https://www.iol.co.za/dailynews/ethekwini-mulls-litter-traps-on-cbds-stormwater-drains-17410279 (Accessed: 11 November 2019).

DBSA (2012) *Regional approaches to food and water security in the face of climate challenges*, *DBSA Policy Brief No.5*. Available at: https://www.scientificamerican.com/article/africa-needs-fossil-fuels-to-end-energy-apartheid/.

DBSA (2016) *Issues and Opportunities in Southern African Water Security*, *DBSA (KMI) Unit*. Pretoria: Development Bank Southern Africa.

DEA (2017) *SA 2nd Annual Climate Change Report*, *Department of Environmental Affairs 2nd Annual Climate Change Report*. Pretoria: Government Printer.

De Wet, F. and Liebenberg, I. (2018) 'Food security, wheat production and policy in South Africa: Reflections on food sustainability and challenges for a market economy', *The Journal for Transdisciplinary Research in Southern Africa*, 14(1), pp. 1–11. doi: https://doi.org/10.4102/td.v14i1.407.

defenceWeb/SAnews (2019) *Vaal River clean-up now a multi-partner operation including the SANDF*, *defenceWeb/SAnews*. Available at: https://www.defenceweb.co.za/sa-defence/sa-defence-sa-defence/vaal-river-clean-up-now-a-multi-partner-operation-including-the-sandf/ (Accessed: 19 December 2019).

defenceWeb (2010) *Dirty water to cost millions of Rand, thousands of jobs : union*, *defenceWeb*. Available at: https://www.defenceweb.co.za/security/human-security/dirty-water-to-cost-millions-of-rand-thousands-of-jobs-union/ (Accessed: 13 February 2020).

Deloitte (2020) *Deloitte commentary on South Africa Budget 2020 / 21. Trade-offs required to achieve shared prosperity*. Available at: https://www2.deloitte.com/za/en/services/tax/deloitte-commentary-2020-21-national-budget.html (Accessed: 16 May 2020).

Dent, E. B. and Bozeman, P. (2014) 'Discovering the foundational philosophies, practices, and influences of modern management theory', *Journal of Management History*, 20(2), pp. 145–163. doi: 10.1108/JMH-09-2012-0056.

Department CoGTA (2019) *Annual Report 2018/19*. Pretoria. Available at: http://www.cogta.gov.za/cgta_2016/wp-content/uploads/2018/11/CoGTA-2019-Annual-Report-Approved-1-compressed-1.pdf.

Department of Defence (2015) *South African Defence Review 2015*. Pretoria: Government Printer.

Department of Science and Technology (2010) *South African Risk and Vulnerability Atlas*, *South African Risk and Vulnerability Atlas by Department of Science And Technology*. Available at: www.rvatlas.org.

DHSW&S (2019a) *Debt owed to water boards : input from COGTA, SALGA, National Treasury & DWS*, *Parliamentary Monitoring Group*. Available at: https://pmg.org.za/committee-meeting/29170/ (Accessed: 29 October 2019).

DHSW&S (2019b) *Department of Water and Sanitation on outstanding debt owed to entities*, *Parliamentary Monitoring Group*. Available at: https://pmg.org.za/committee-meeting/29118/ (Accessed: 13 November 2019).

Dickie, P. (2007) *Making Water. Desalination : option or distraction for a thirsty world?*, *WWF*. Available at: https://mobil.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/making_water_desalination_report.pdf.

Donnelly, L. (2019) *Latest tax stats underscore toll taken by poor GDP growth*, *Business Live*. Available at: https://www.businesslive.co.za/bd/economy/2019-12-23-latest-tax-stats-underscore-toll-taken-by-poor-gdp-growth/?utm_term=Autofeed&utm_medium=Social&utm_source=Facebook#Echobox=1577329655 (Accessed: 26 December 2019).

Donnenfeld, Z., Crookes, C. and Hedden, S. (2018) 'A delicate balance: Water scarcity in South Africa', *ISS Southern Africa Report 13*, 13(March), pp. 1–24. Available at: https://issafrica.org/research/southern-africa-report/a-delicate-balance-water-scarcity-in-south-africa.

Donnenfeld, Z. (2019) *Water security in South Africa : forgotten but not gone*, *ISS Africa*. Available at: https://issafrica.org/iss-today/water-security-in-south-africa-forgotten-but-not-gone (Accessed: 5 May 2019)

Du Plessis, J. A. (2010) *Integrated Water Demand Management for Local Water Governance*. Thesis (PhD). Stellenbosch: Stellenbosch University.

Du Plessis, W. (2019) *Bold start to 2019 for LHWP*, *Online: Construction World*. Available at: www.crown.co.za/latest-news/construction-world-latest-news/8603-bold-start-to-2019-for-lhwp (Accessed: 2 July 2019).

DWA (2013) *National Water Research Strategy 2*. Available at: http://www.dwa.gov.za/documents/Other/Strategic Plan/NWRS2-Final-email-version.pdf. (Accessed: 12 December 2018).

Englebert, P. and Dunn, K. C. (2014) *Inside African Politics*. Boulder, Colorado: Lynne Rienner Publishers.

EPA. Australia (2011) *Stormwater Pollution*. Available at: http://www.ryde.nsw.gov.au/Environment/Water+Quality+and+Pollution/Stormwater+Pollution (Accessed: 11 November 2011).

EWN Reporter (2019) 'There's no Water but we still have to pay, says Graaff-Reinet Resident', *EWN*, 20 November. Available at: https://ewn.co.za/2019/11/21/there-s-no-water-but-we-still-have-to-pay-says-graaff-reinet-resident.

Faling, W., Tempelhoff, J. W. N. and van Niekerk, D. (2012) 'Rhetoric or action: Are South African municipalities planning for climate change?', *Development Southern Africa*, 29(2), pp. 241–257. doi: 10.1080/0376835X.2012.675695.

FAO UN (2016) *South Africa: Geography, Climate and Population*. Available at: http://www.fao.org/nr/water/aquastat/countries_regions/uzb/uzb-cp_eng.pdf.

Fayol, H. (1954) *General and Industrial Management*. Translated from French to English by Constance Storrs. Second Edi. London: Sir Isaac Pitman and Sons, Ltd. (Original work published in 1949.) Available at: https://ia801600.us.archive.org/4/items/in.ernet.dli.2015.13518/2015.13518.General-And-Industrial-Management.pdf.

Flanagan, N. and Finger, J. (2000) *Just about everything a manager needs to know in South Africa*. Cape Town: Zebra Press.

Fox, W. and Bayat, M. S. (2014) *A Guide To Managing Research*. Cape Town: Juta & Co Ltd.

Francis, A. (2018) *MBA Knowledge Base*. Available at: https://www.mbaknol.com/?s=fayol (Accessed: 4 August 2019).

Fusch, P. I. and Ness, L. R. (2015) *Are We There Yet? Data Saturation in Qualitative Research*, *The Qualitative Report*. Available at: http://www.nova.edu/ssss/QR/QR20/9/fusch1.pdf. (Accessed: 2 January 2019).

Gambade, E. (2019) 'Summer in South Africa, heatwaves and the very real effects of climate crisis', *Daily Maverick*, 16 September, pp. 1–7. Available at: https://www.dailymaverick.co.za/article/2019-09-16-summer-in-south-africa-heatwaves-and-the-very-real-effects-of-climate-change/.

GCIS (2019a) *Annual Report*, *Annual Report 2017/18*. Pretoria: Government Printer. doi: 10.1017/CBO9781107415324.004.

GCIS (2019b) 'Energy', in Miriam Mokoena (ed.) *South Africa Yearbook 2017/18*. 25th edn. Pretoria: Government Printer, p. 16. Available at: https://www.gcis.gov.za/sites/default/files/docs/resourcecentre/yearbook/8-Energy2018.pdf.

Gleick, P. and Iceland, C. (2018) *Water, Security, and Conflict*. Available at: https://wriorg.s3.amazonaws.com/s3fs-public/water-security-conflict.pdf?_ga=2.196665001.44588036.1543155666-1767902656.1543155666.

Greenblo, A. (2019) *Social grant system has failed to uplift South Africans*, *Business Live*. Available at: https://www.businesslive.co.za/fm/opinion/2019-07-15-allan-greenblo-social-grant-system-has-failed-to-uplift-south-africans/ (Accessed: 18 December 2019).

Groves, D. *et al.* (2015) 'Adaptation to Climate Change in Project Design', in Cervigni, R. et al. (eds) *Enhancing the Climate Resilience of Africa's Infrastructure: The Power and Water Sectors*. Washington DC: International Bank for Reconstruction and Development / The World Bank, p. 219. doi: DOI: 10.1596/978-1-4648-0466-3.

Haldewang, B. (2009) 'The state of water in South Africa – are we heading for a crisis?', *Institute for Futures Research*. Stellenbosch: Institute for Futures Research, University of Stellenbosch, 7(01), pp. 1–5.

Hart-Davis, A.(Ed). (2009). *Science: The Definitive Visual Guide*. London: Penguin Books.

Head, T. (2019) *South Africa's debt has cracked R3 trillion: Here's where the money is going*, *The South African*. Available at: https://www.thesouthafrican.com/news/south-africa-total-debt-money-where-r3trn/ (Accessed: 16 January 2020).

Health-E News (2019) 'Dire water crises continue to plague communities across SA.', *The Citizen*, 26 March. Available at: https://citizen.co.za/news/south-africa/health/2106351/dire-water-crises-continue-to-plague-communities-across-sa/.

Hedden, S. and Cilliers, J. (2014) 'Parched prospects: The emerging water crisis in South Africa', *African Futures Paper*. Pretoria: Institute for Security Studies, (September). doi: 10.1111/j.1548-1425.2009.01200.x.

Hedden, S. (2016) *Parched prospects II: A revised long-term water supply and demand forecast for South Africa*. Available at: https://issafrica.s3.amazonaws.com/site/uploads/AF16.pdf (Accessed: 25 December 2018).

Honderich, T. (Ed). (1995) The *Oxford Companion to Philosophy*. New York: Oxford University Press.

IHE Delft Institute for Water Education and Partners (2020) *About the Water, Peace and Security Partnership: The Problem : Water Insecurity is on the Rise*, *Water Peace and Security*. Available at: https://waterpeacesecurity.org/info/about-wps (Accessed: 12 April 2020).

International Bank for Reconstruction and Development (2018) *Overcoming Poverty and Inequality in South Africa: An Assessment of Drivers, Constraints and Opportunities*. Edited by W. P. Hurlbut. Washington: The World Bank.

Ketchen Jr. D., J. and Short J., C. (2011) 'Separating fads from facts: Lessons from the Good, the Fad, and the Ugly', *Business Horizons*, 54(1), pp. 17–22. Available at: https://sun-primo.hosted.exlibrisgroup.com/primo-explore/fulldisplay?docid=TN_sciversesciencedirect_elsevierS0007-6813(10)00099-6&context=PC&vid=27US_V1&lang=en_US&search_scope=Combined_Search&adaptor=primo_central_multiple_fe&tab=combined_search&query=an.

Keulder, C. J. (1996) *Trends in the Modern World Economy and Democratisation in Peripheral States.* Pretoria: HSRC Publishers.

Kings, S. (2017) '50 000 litres of sewage flow into SA's rivers every second _ News _ Environment _ M&G', *Mail & Guardian*, 21 July, pp. 1–6. Available at: https://mg.co.za/article/2017-07-21-south-africas-shit-has-hit-the-fan.

Kings, S. (2018a) 'An El Niño away from water crisis', *Mail & Guardian*, 7 December, pp. 1–9. Available at: https://mg.co.za/article/2018-12-07-00-an-el-nino-away-from-water-crisis.

Kings, S. (2018b) 'Flushing money down the loo', *Mail and Guardian*, 31 August, pp. 1–5. Available at: https://mg.co.za/article/2018-08-31-00-flushing-money-down-the-loo.

Klein Leichman, A. (2019) *How Israel swims against tide of worldwide water crisis | ISRAEL21c*, *Israel 21c: Uncovering Israel*. Available at: https://www.israel21c.org/how-israel-swims-against-tide-of-worldwide-water-crisis/ (Accessed: 8 February 2020).

Kuhlman, M. U. A. (2018) 'Strengthening Partnerships to Face the Complexities of Africa', *Military Review*, (November-December).

Kuhn, T.S. (1968). *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press.

Kwok, A. C. F. (2018) 'The Evolution of Management Theories: A Literature Review', *Nang Yan Business Journal*, 3(1), pp. 28–40. doi: 10.1515/nybj-2015-0003.

Lambert, V. A. and Lambert, E. (2012) 'Editorial : Qualitative Descriptive Research : An Acceptable Design', *Pacific Rim International Journal of Nursing Research*, 16(4), pp. 255–256.

Le Page, D., Davies, T. D. and Hamilton, G. (2019) 'Climate change must be a central pillar of SA ' s economic growth.', *Business Day*, 6 February, pp. 1–2. Available at: https://www.businesslive.co.za/bd/opinion/2019-02-06-climate-change-must-be-a-central-pillar-of-sas-economic-growth/.

Lewis, A. H. (1906) 'It's only nine meals between men and revolution', *Cosmopolitan Magazine*, March, pp. 1–4. doi: 10.1017/CBO9781107415324.004.

Luke, C. (2011) 'Best management practices', *Journal of Management Development*. New York: Emerald Group Publishing Limited, 30(1), pp. 93–105. doi: 10.1108/02621711111098398.

Mabey, C. (2007) *Developing Effective Managers and Leaders*. Edinburgh: Edinburgh Business School. Available at: https://eprints.utas.edu.au/17611/1/Whole-Wallace-thesis-ex-pub-mat.pdf.

Mackintosh, G. and Colvin, C. (2003) 'Failure of rural schemes in South Africa to provide potable water', *Environmental Geology*. Stellenbosch: Cape Water Programme, CSIR, 44(1), pp. 101–105. doi: 10.1007/S00254-002-0704-Y.

Madsen, M. T. (2001) *Leadership and Management Theories Revisited*. DDL Working Paper No 4. DDL Project: Copenhagen. Available at: www.org.hha.dk/org/ddl.

Makwetu, K. (2019a) *AG Consolidated General Report on the Local Government Audit Outcomes FY 2017/18*. Pretoria. Available at: https://www.agsa.co.za/Portals/0/MFMA2017-18 - A_Snapshot and clean audits.pdf.

Makwetu, K. (2019b) *Auditor-general flags lack of accountability as the major cause of poor local government audit results*. Available at: https://www.agsa.co.za/Portals/0/Reports/MFMA/2019.06.25/2019 MFMA Media Release.pdf.

Makwetu, K. (2019c) *Executive Summary AG Report on Local Government FY 2017/18*, *Executive Summary*. Pretoria. Available at: https://www.agsa.co.za/Portals/0/Reports/MFMA/2019.06.25/MFMA2017-18 - Section 1 - Executive summary.pdf.

Makwetu, K. (2020a) *Auditor-general: Municipal audit results under the theme - "not much to go around, yet not the right hands at the till"*. Pretoria. Available at: https://www.agsa.co.za/Portals/0/Reports/MFMA/201819/Media Release/2020 MFMA Media Release Final.pdf.

Makwetu, K. (2020b) *Consolidated General Report MFMA 2018/19*, *AG Consolidated General Report on the Local Government Audit Outcomes FY 2018/19.* Pretoria. doi: 10.1017/CBO9781107415324.004.

Marrian, M. (2007) *Vaal River pollution a 'crisis', says scientist*, *Mai&Guardian*. Available at: https://mg.co.za/article/2007-11-20-vaal-river-pollution-a-crisis-says-scientist (Accessed: 19 December 2019).

Marwala, T. (2020) *When the climate crisis and 4IR converge, a new economy beckons*, *Daily Maverick*. Available at: https://www.dailymaverick.co.za/opinionista/2020-01-30-when-the-climate-crisis-and-4ir-converge-a-new-economy-beckons/?tl_inbound=1&tl_groups[0]=80895&tl_period_type=3&utm_medium=email&utm_campaign=Afternoon Thing Thursday 30 January 2020 The Gathering&ut (Accessed: 30 January 2020).

Mathieu, J. E. (2016) 'The Problem with [in] management theory', *Journal of Organizational Behavior*. Storrs, USA: University of Connecticut, 37(3), pp. 1132–1141. doi: 10.1002/job.

Mavuso, Z. (2015) 'Inside Government's War on Leaks Project as Water Worries Rise', *Engineering News*, November, pp. 1–15. Available at: http://www.engineeringnews.co.za/article/inside-governments-war-on-leaks-project-as-water-worries-rise-2015-11-20.

Mbiyozo, A. N. (2020) *What does the climate refugees judgment mean for Africans ?*, *ISS Africa*. Available at: https://issafrica.org/iss-today/what-does-the-climate-refugees-judgment-mean-for-africans (Accessed: 12 April 2020).

McDonald, P. (2011) 'It's time for management version 2.0: Six forces redefining the future of modern management', *Futures*. Elsevier Ltd, 43(8), pp. 797–808. doi: 10.1016/j.futures.2011.05.001.

McSweeney, R. and Timperley, J. (2018) *Carbon Brief Profile: South Africa's heavy dependence on coal and expanding effort to develop renewables.*, *Online*. Available at: https://www.carbonbrief.org/the-carbon-brief-profile-south-africa (Accessed: 18 June 2019).

Meissner, R. *et al.* (2018) 'South African local government perceptions of the state of water security', *Environmental Science and Policy*. Elsevier, 87(April), pp. 112–127. doi: 10.1016/j.envsci.2018.05.020.

Mobjörk, M. (2016) 'Integrated Policy Responses for Addressing Climate-', *SIPRI Policy Brief*. Stockholm: SIPRI, (October), pp. 1–4. Available at: https://www.sipri.org/publications/2016/sipri-policy-briefs/integrated-policy-responses-addressing-climate-related-security-risks.

Molobela, P. and Sinha, P. (2011) 'Management of water resources in South Africa: A review', *African Journal of Environmental Science and Technology*. Pretoria: Academia Journals, 5(12), pp. 993–1002. doi: 10.5897/AJEST11.136.

Monteiro, A. (2019) *Lack of funds means SA can ' t stop sewage polluting dam*, *Moneyweb*. Available at: https://www.moneyweb.co.za/news-fast-news/lack-of-funds-means-sa-cant-stop-sewage-polluting-dam/ (Accessed: 15 October 2019).

Moubray, C. (2019) *South Africa unprepared for drought disaster, AgriSA warns government*, *Daily Maverick*. Available at: https://www.dailymaverick.co.za/article/2019-11-13-south-africa-unprepared-for-drought-disaster-agrisa-warns-government/ (Accessed: 28 December 2019).

Mthethwa, A. (2019) 'Master plan aims to inject urgency into water crisis management', *Daily Maverick*, 29 November, pp. 1–11. Available at: https://www.dailymaverick.co.za/article/2019-11-29-master-plan-aims-to-inject-urgency-into-water-crisis-management/.

Mulaudzi, M. and Liebenberg, I. (2017) 'Planning and Socio-Economic Interventions in a Developmental State : The Case of South Africa', *Journal of Public Administration*, 52(1), p. 24. Available at: https://www.academia.edu/33983341/Planning_and_Socio-Economic_Intervention_in_a_Developmental_State_The_case_of_South_Africa.

Muller, M. *et al.* (2009) 'Water Security in South Africa', *Development Planning Division Working Paper Series*. DBSA: Midrand, 12(12), p. 40.

Muller, M. (2016) *Lessons from South Africa on the Management and Development of Water Resources for Inclusive and Sustainable Growth*, *European Report on Development*. Johannesburg. doi: 10.2139/ssrn.2333044.

Muller, M. *et al.* (2018) *Water Security Plan for the Gauteng City-Region: Office of the Premier of Gauteng*. Johannesburg.

Muller, M. (2019) 'The real water crisis: Not understanding what ' s needed', *Mail & Guardian*, 10 November, pp. 10–12. Available at: https://mg.co.za/article/2019-11-07-the-real-water-crisis-not-understanding-whats-needed?utm_medium=Social&utm_source=Facebook#Echobox=1573379596.

National Planning Commission (2012) *National Planning Commission Our future- make it work National Development Plan 2030*. Pretoria: Government Printer. doi: ISBN: 978-0-621-41180-5.

National Planning Commission (2013) *Executive Summary: Our future - make it work: National Development Plan 2030*. Pretoria: Government Printer.

Ngalonkulu, M. (2020) *South African economy contracts third quarter in a row*, *Moneyweb*. Available at: https://www.moneyweb.co.za/news/south-africa/south-african-economy-contracts-third-time-in-a-row/ (Accessed: 5 July 2020).

Ngozo, T. (2018) 'Basic education is failing the economy - The Mail & Guardian', *Mail & Guardian*, 23 November, pp. 1–5. Available at: https://mg.co.za/article/2018-11-23-00-basic-education-is-failing-the-economy/.

Njobeni, S. (2019) 'How Municipalities are destroying SA business', *Business Live*, 27 June, pp. 1–8. Available at: https://www.businesslive.co.za/fm/features/cover-story/2019-06-27-how-municipalities-are-destroying-sa-business/.

NSDF Draft (2019) *Draft National Spatial Development Framework*. Pretoria. Available at: http://pmg-assets.s3-website-eu-west-1.amazonaws.com/200120Draft_NSDF.pdf.

Nugraha, A. and Madu, L. (2013) 'Human Security : Contending Perspectives of Liberalism, Critical Theory and Postcolonial Theory', *Global Strategies*, pp. 73–89. Available at: https://www.academia.edu/38100554/Human_Security_Contending_Perspectives_of_Liberalism_Critical_Theory_and_Postcolonial_Theory.

NW&SMP (2018a) *National Water & Sanitation Master Plan : Vol 2 : Plan to Action : 2018 (Final Draft)*, *Department of Water and Sanitation Master Plan*. Pretoria: Government Printer. Available at: http://www.dwa.gov.za/National Water and Sanitation Master Plan/Documents/20180329 NWSMP Volume 2 Final Draft (3.3).pdf.

NW&SMP (2018b) *National Water and Sanitation Master Plan : Vol 1 : Call to Action v9 .4.*, *National Water and Sanitation Master Plan vers 9.4*. Pretoria: Government Printer. Available at: http://www.dwa.gov.za/National Water and Sanitation Master Plan/Documents/NWSMP Call to Action Final Draft PDF.pdf.

Overy, N. (2020) 'Water-guzzling coal-fired power stations are not the answer', *Business Day*, 20 January, p. Online. Available at: https://www.businesslive.co.za/bd/opinion/2020-01-20-water-guzzling-coal-fired-power-stations-are-not-the-answer/?utm_medium=Social&utm_source=Facebook#Echobox=1579543658.

Paris, R. (2002) 'Human Security: Paradigm Shift or Hot Air?', *International Security*. Boulder, Colorado: Harvard College, 26(2), pp. 87–102. doi: 10.1162/016228801753191141.

Patter, R. (2019) 'Makhanda ' s thirst caused by inept officials and misrule', *Mail & Guardian*, 1 February, pp. 1–16. Available at: https://mg.co.za/article/2019-02-01-00-makhandas-thirst-caused-by-inept-officials-and-misrule.

Payne, S. (2019) 'Karoo town of Beaufort West and local farms parched and running out of water', *Daily Maverick*, 25 January, pp. 1–9. Available at: https://www.dailymaverick.co.za/article/2019-01-25-karoo-town-of-beaufort-west-and-local-farms-parched-and-running-out-of-water/.

Phakgadi, P. (2018) 'Vaal water crisis : ' Why are investigations only beginning now ?'', *News 24*, 19 November, pp. 1–6. Available at: https://www.news24.com/SouthAfrica/News/vaal-water-crisis-why-are-investigations-only-beginning-now-20181119.

Pijoos, I. (2019) *Mangaung metro placed under administration*, *Times Live*. Available at: https://www.timeslive.co.za/news/south-africa/2019-12-20-mangaung-metro-placed-under-administration/ (Accessed: 1 January 2020).

Portfolio Committee on Water and Sanitation (2018) *Report of the Portfolio Committee on Water and Sanitation of the 2018/19 Strategic Plans; Vote 36*, *Online*. doi: 10.1590/s1809-98232013000400007.

Prinsloo, J. and Roos, M. (2006) *Performance Auditing: A step-by-step approach*. Pretoria: Van Schaik Publishers.

Prussakov, G. (2009) *18 Leadership Principles from Colin Powell*, *AM Navigator*. Available at: https://www.amnavigator.com/blog/2009/06/03/18-leadership-principles-from-colin-powell/ (Accessed: 30 September 2019).

Pryor, M. G. and Taneja, S. (2010) 'Henri Fayol, practitioner and theoretician - revered and reviled', *Journal of Management History*. Emerald Group Publishing Limited, 16(4), pp. 489–503. doi: 10.1108/17511341011073960.

Reporter, A. (2019) *DA wants money ring-fenced as Harrismith services ' collapse '*, *IOL News*. Available at: https://www.iol.co.za/news/south-africa/free-state/da-wants-money-ring-fenced-as-harrismith-services-collapse-39360733 (Accessed: 1 January 2020).

Reuters (2018) 'UN: Half of Drought-Hit Somalia Needs Aid in 2018', *Reuters*, 17 January, p. 2. Available at: https://www.voanews.com/a/un-half-of-drought-hit-somalia-needs-aid-in-2018/4211838.html (Accessed: 31 December 2018).

Risi, L. (2019) *Beyond Water Wars*, *Wilson Quarterly*. Available at: https://www.wilsonquarterly.com/quarterly/water-in-a-world-of-conflict/beyond-water-wars/ (Accessed: 23 August 2019).

Ritchie, G. (2018) 'Beaufort West runs out of water', *Mail & Guardian*, 24 August. Available at: https://mg.co.za/article/2018-08-24-00-beaufort-west-runs-out-of-water/.

Roos, M. and Stainbank, L. (eds) (2017) *Accounting and Editing Practices in Africa*. Stellenbosch: Sun Press.

Roux, S., Oelofse, S. and Lange, W. De (2010) 'Can SA afford to continue polluting its water resources ? – With special reference to water pollution in two important catchment areas', *Science real and relevant conference*, pp. 1–13. doi: NE09-PA-F.

SAHRC (2014) *Water is Life. Sanitation is Dignity: Accountability to People who are Poor. Report on the Right to Access Sufficient Water and Decent Sanitation in South Africa: 2014*. Available at: http://www.sahrc.org.za/home/21/files/FINAL 4th Proof 4 March - Water Sanitation low res %282%29.pdf.

Sarker, M. S. I. and Khan, M. R. A. (2013) 'Classical and Neoclassical Approaches of Management: An Overview', *IOSR Journal of Business and Management*, 14(6), pp. 01–05. doi: 10.9790/487x-1460105.

Schmeier, S. and Iceland, C. (2020) *Water, Peace and Security: The Coronavirus Pandemic*, *The Hague Centre for Strategic Studie*. Available at: https://waterpeacesecurity.org/info/blog-04-01-2020-coronavirus-pandemic (Accessed: 12 April 2020).

Semenya, M. (2019) *HS,W&S Budgetary Review and Recommendations Report*, *HSW&S Parliamentary Budgetary Review 2019*. Available at: https://pmg.org.za/committee-meeting/29156/ (Accessed: 3 February 2020).

Skowno, A. L. *et al.* (2019) *National Biodiversity Assessment 2018: The Status of SA's ecosystems and Biodiversity. Synthesis Report.*, *South African National Biodiversity Institute*. Edited by C. (Dr) Seymour. Pretoria. Available at: http://bgis.sanbi.org/NBA/NBA2011_metadata_formalprotectedareas.pdf%5Cnpapers2://publication/uuid/786A77C5-B11A-4F8D-B139-F3F626EBC802.

Smith, I. and Boyns, T. (2005) 'British management theory and practice: the impact of Fayol', *Management Decision*, 43(10), p. 1317. Available at: http://hud.summon.serialssolutions.com/link/eJx9ktuO0zAQhlNOggUeY_fGShrHyTaNZBDdUuhFOaV7w01lksnG3djO2k62fVMeBzfRgpAQF5Y9n__5Zzyy573Jrzebz5_8_H2er90u7uEHDlqtysB0QigZGNCcNcaoprNcSRMUSvjRZZzM_WQ28c6-XcUft-Rrnn55NPlZW9tm06ku4tqSO5O2Lp3pov6ny9vCHnY9aPqdzIM09aM.

South Africa (1996) *Constitution of the Republic of South Africa Act, Act 108 of 1996*, *Government Gazette*. Pretoria: Government Printer.

South Africa (1997) *Water Services Act, Act 108 of 1997*, *Government Gazette*. Pretoria: Government Printer.

South Africa (1998a) *National Environmental Management Act, Act 107 of 1998*, *Government Gazette*. Pretoria: Government Printer.

South Africa (1998b) *National Water Act, Act 36 of 1998*, *Government Gazette*. Pretoria: Government Printer.

South Africa (2015) *South Africa Yearbook 2015/16: Water and Sanitation*. Pretoria: Government Printer.

South Africa (2017) *South Africa Yearbook 2017/18: Water and Sanitation*. Pretoria: Government Printer. Available at: https://www.gcis.gov.za/sites/default/files/docs/resourcecentre/yearbook/24-WaterandSanitation2018.pdf.

South Africa (2018) *Department of Water and Sanitation Annual Report FY 2017/18*. Pretoria: Government Printer. doi: 10.1053/j.tvir.2012.02.004.

South Africa (2020) *SARS Prelimenary Revenue Outcome for 2019-20*, *SARS*. Available at: https://www.sars.gov.za/Media/MediaReleases/Pages/1-April-2020-Preliminary-revenue-outcome-for-2019-20.aspx (Accessed: 16 May 2020).

South Africa SCOPA Presentation (2020) *Briefing by National Treasury on Financial Implications of COVID-19 on both the Economy and Budget presented to SCOPA*. Pretoria.

Staff Reporter. (2019) *Litter blocks stormwater drains on Corlett Drive – Plastic pollution is a growing problem.*, *Sandton Chronicle*. Available at: https://sandtonchronicle.co.za/220135/litter-blocks-storm-water-drains-corlett-drive/ (Accessed: 11 November 2019).

Staff Writer (2019a) 'Drought tightens its grip on Makhanda', *Grocott's Mail*. Available at: https://www.grocotts.co.za/2019/09/20/drought-tightens-its-grip-on-makhanda/.

Staff Writer (2019b) *Gansbaai first to test new stormwater net system to trap litter*, *IOL News*. Available at: https://www.iol.co.za/capetimes/news/gansbaai-first-to-test-new-stormwater-net-system-to-trap-litter-28880311 (Accessed: 11 November 2019).

Staff Writer (2020a) *More than a million jobs on the line because of Covid-19 lockdown : economist*, *BusinessTech*. Available at: https://businesstech.co.za/news/business/388629/more-than-a-million-jobs-on-the-line-because-of-covid-19-lockdown-economist/ (Accessed: 30 April 2020).

Staff Writer (2020b) *New radical plan for smaller towns in South Africa*, *Businesstech*. Available at: https://businesstech.co.za/news/government/368044/new-radical-plan-for-smaller-towns-in-south-africa/ (Accessed: 27 January 2020).

Stats SA (2015) *Millenium Development Goals Country Report*. Pretoria. Government Printer. Available at: http://www.statssa.gov.za/MDG/MDG_Country Report_Final30Sep2015.pdf.

Stats SA (2017) *Education Series Volume III: Educational Enrolment and Achievement, 2016*. Pretoria. Government Printer. Available at: www.statssa.gov.za.

Stats SA (2018) *Content Publications Statistics by Place Statistics by Theme*. Pretoria. Government Printer. Available at: http://www.statssa.gov.za/?p=11361 (Accessed: 31 December 2018).

Stats SA (2019a) *Annual Report 2018/19 Book 1*, *Book 1*. Pretoria: Government Printer. Available at: http://www.statssa.gov.za/publications/AnnualReport/AR201819_Book_1.pdf.

Stats SA (2019b) *Statistical Release*, *Mid Year Population Estimates 2019*. Pretoria. Government Printer. Available at: http://www.statssa.gov.za/publications/P0302/P03022019.pdf.

Stats SA (2019c) 'Quarterly Labour Force Survey Q3:2019', *Quarterly Labour Force Survey*, PO211(May), pp. 1–70. Pretoria. Government Printer. Available at: http://www.statssa.gov.za/publications/P0211/P02112ndQuarter2019.pdf.

Stern, N. (2007) *Stern Review : The Economics of Climate Change*. London: Government Printer. Available at: http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/sternreview_report_complete.pdf.

Tapela, B. N. (2012) *Social Water Security and Water Use*. Pretoria: Water Research Commission. Available at: ww.wrc.org.za.

Tapela, B., Ntwana, B. and Sibanda, D. (2015) *Social Protest and Water Service Delivery in South Africa*, *Water Research Commission Report No. TT631/15*.

The Centre for Development and Enterprise (2010) 'Round Table - Water : a looming crisis ?', in Bernstein, A. (ed.) *The Round Table*. The centre for Development and enterprise transmedia Place.

The Hague Centre for Strategic Studies (2018) *HCSS Water, Peace and Security*, *Water Peace and Security*. Available at: https://hcss.nl/news/water-peace-and-security (Accessed: 12 April 2020).

The Merriam-Webster.com Dictionary (2019) *Tipping Point*, *The Merriam-Webster.com Dictionary*. Available at: https://www.merriam-webster.com/dictionary/tipping point (Accessed: 13 December 2019).

The World Climate and Security Report 2020 (2020) *The 2020 World Climate and Security Report*. Edited by F. Femia and C. Werrell. Center for Climate and Security, an institute of the Council on Strategic Risks. Available at: https://climateandsecurity.org/worldclimatesecurityreport2020/.

Turton, A. (2008) 'Three Strategic Water Quality Challenges that Decision-Makers Need to Know About and How the CSIR Should Respond Keynote', in. Available at: CSIR Report No. CSIR/NRE/WR/EXP/2008/0160/A.

Turton, A. and Henwood, R. (2002) *Hydropolitics in the developing world: A Southern African perspective*. Edited by A. R. Turton and R. Henwood. Pretoria: African Water Research Unit, University of Pretoria. Available at: http://agris.fao.org/agris-search/search/display.do?f=2012/QL/QL1201.xml%5CnQL2012001203%5Cnpapers3://publication/uuid/E88434A3-D893-4739-BA16-8F1A66DC94B7.

UN Office for Humanitarian Affairs (2020) *Lake Chad Basin : Crisis Update (June 2019)*, *ReliefWeb*. Available at: https://reliefweb.int/report/nigeria/lake-chad-basin-crisis-update-june-2019 (Accessed: 8 February 2020).

UNESCO (2015) *WWAP (United Nations World Water Assessment Programme). 2015. The United Nations World Water Development Report 2015: Water for a Sustainable World. Paris, UNESCO.* Paris, France. Available at: http://unesdoc.unesco.org/images/0023/002318/231823E.pdf.

United Nations (2015) 'The Millennium Development Goals Report', *United Nations*. New York: United Nations, p. 72. doi: 978-92-1-101320-7.

United Nations (2018) *Sustainable Development Goal 6 Synthesis Report on Water and Sanitation*. New York: United Nations. doi: 978-92-1-101370-2.

United Nations Development Programme (2006) *Human Development Report 2006: Beyond Scarcity: Power, poverty and the global water crisis*, *Journal of Government Information*. New York: The United Nations Development Programme (UNDP). doi: ISBN 978-0-230-54704-9.

Vaal River Pollution (2020a) *Untreated Sewage spilling into the Vaal River.* [online image]. Available at: https://m.facebook.com/story.php?story_fbid=4375209082519897&id=962582647115908&__tn__=%2As%2As-R (Accessed: 27 July 2020).

Vaal River Pollution (2020b) Fish die-offs in the Vaal. [online image]. Available at: http://www.save.org.za/misleading-media-reports-on-vaal-river-pollution/ (Accessed: 27 July 2020).

Van der Merwe-Botha, M. (2009) 'Water Quality: A vital dimension of water security Development Planning Division Working Paper Series No. 14', *DBSA*: Midrand, (14), p. 32.

Van Niekerk, D. *et al.* (2009) *The effects of climate change in two flood laden and drought stricken areas in South Africa: Responses to climate change – past, present and future*. Potchefstroom. Available at: https://scholar.google.com/scholar?cluster=5763832712425032 67&hl=en&oi=scholarr#d=gs_cit&u=%2Fscholar%3Fq%3Dinfo%3AYxTjCIi5_wcJ%3Ascholar.google.com%2F%26output%3Dcite%26scirp%3D0%26scfhb%3D1%26hl%3Den.

Van Zyl, G. (2019) *Budget 2019: Eskom risks pushing debt-to-GDP ratio up to 60%*, *Biznews*. Available at: https://www.biznews.com/budget/2019/02/18/eskom-risks-debt-gdp-ratio-60 (Accessed: 13 December 2019).

Visser, A. (2020) *Tax reprieve for South Africans in 2020*, *Moneyweb*. Available at: https://www.moneyweb.co.za/in-depth/budget/tax-reprieve-for-south-africans-in-2020/ (Accessed: 16 May 2020).

Voxted, S. (2017) '100 years of Henri Fayol', *Management Review*, 28(2), pp. 256–274. doi: 10.5771/0935-9915-2017-2-256.

Walters, T. (2019) *Mega climate shocks for SA biodiversity — government report*, *The Daily Maverick*. Available at: https://www.dailymaverick.co.za/article/2019-10-11-mega-climate-shocks-for-sa-biodiversity-government-report/?fbclid=IwAR0HqKJFU-3_CWhQ1m3qcxmn-ZZ0dNXX5hkL4IM-aH_aLlgcX3J7AcI1EuA (Accessed: 25 October 2019).

Water Shortage SA and OUTA (2019) *Position Paper for an Independent Water Regulator*. Available at: https://www.watershortagesa.com/wp-content/uploads/2019/04/OUTA-and-WSSA-Position-Paper-for-IWR_.pdf.

Welborn, L. (2018) 'Africa and climate change: Projecting vulnerability and adaptive capacity', *Africa Report 14*. Pretoria: ISS Pretoria, (November), pp. 1–24. Available at: https://issafrica.org/research/africa-report/africa-and-climate-change-projecting-vulnerability-and-adaptive-capacity.

Wenming, S. (ed.) (1984) 'Reform of the Managerial System', in *On Rolls the Green Revolution*. Beijing: China International Book Trading, pp. 99–124.

Wentink, G. J. and Van Niekerk, D. (2017) 'The capacity of personnel in disaster risk management in South African municipalities', *The Journal for Transdisciplinary Research in Southern Africa*, 13(1), pp. 1–10. doi: 10.4102/td.v13i1.427.

Weymes, E. (2004) 'Management Theory: Balancing Individual Freedom with Organisational Needs', *The Journal of Corporate Citizenship*, 16(1911), pp. 85–98. Available at: https://search.proquest.com/central/docview/211913643/fulltextPDF/1836F2CDF2D4D24PQ/1?accountid=149513%0Ahttp://www.jstor.org/stable/jcorpciti.16.85.

Williams, P. D. (ed.) (2013) *Security Studies An Introduction*. 2nd edn. London: Routledge Taylor & Francis Group.

Willis, H. *et al.* (2016) *Developing the Pardee RAND Food-Energy-Water Security Index: Toward a Global Standardized, Quantitative, and Transparent Resource Assessment*. Santa Monica, Calif. doi: 10.7249/TL165.

World Population Review (2019) *South Africa Population 2019*, *World Population Review*. Available at: http://worldpopulationreview.com/countries/south-africa-population/.

WRC, DS&T and DW&S (2015) *South Africa's Water Research, Development, and Innovation (RDI) Roadmap: 2015-2025*. Pretoria.

Wren, D. A. (2001) Henri Fayol as strategist: A nineteenth century corporate turnaround', *Management Decision*, 39(6), pp. 475–487. doi: 10.1108/EUM0000000005565.

Wren, D. A. and Bedeian, A. G. (2009) 'The Emergence of the Management Process and Organisation Theory', in *The Evolution of Management Thought*. 6th edn. Hoboken NJ: John Wiley & Sons, Inc, p. 28.

WWAP (United Nations World Water Assessment Programme) (2015) *The United Nations World Water Development Report 2015: Water for a Sustainable World*. Paris. Available at: http://unesdoc.unesco.org/images/0023/002318/231823E.pdf.

WWAP (United Nations World Water Assessment Programme) (2017) *UN World Water Development Report 2017. Wastewater: The Untapped Resource*. Paris. doi: 10.1017/CBO9781107415324.004.

WWAP (UNESCO World Water Assessment Programme) (2019) *The United Nations World Water Development Report 2019: Leaving No One Behind.* Paris: UNESCO.

WWF-SA (2013) *An Introduction to South Africa's Water Sources*. Edited by E. Prince and S. Nobula. Pretoria: WWF South Africa. Available at: www.journeyofwater.co.za.

WWF-SA (2016) *Water: Facts and Futures Rethinking South Africa's Water Future*, *Water: Fact and Futures*. Edited by WWF-SA and H. Dugmore. Cape Town: WWf South Africa. Available at: http://awsassets.wwf.org.za/downloads/wwf009_waterfactsandfutures_report_web__lowres_.pdf.